REFINING SPECTRORADIOMETRIC TEMPERATURE DETERMINATION IN THE LASER-HEATED DIAMOND ANVIL CELL, WITH IMPACT ON THE EQUATION OF STATE OF IRON.

Undergraduate Senior Research Thesis
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ABSTRACT

Quantification of the physical properties of iron under core conditions is necessary to understand the Earth's deep interior. Many experiments have been done to determine its high pressure, high temperature equation of state (EOS); however, many iron EsOS are mutually inconsistent. We explore sources of experimental temperature error with the potential impact that a lack of precision in experimental temperature may have on the EOS of iron in mind. Laser-heated diamond anvil cells (LHDACs) are widely used tools for researching materials at deep-Earth pressure and temperature conditions. Temperature in the LHDAC is determined by spectroradiometry, where the temperature (T) of a laser-heated sample is determined using the gray-body approximation of Planck's law of black-body radiation, which relates the measured intensity (I) of light emitted from the sample to the sample's temperature as a function of the wavelength of the emitted light (λ), assuming wavelength-independent emissivity ($\varepsilon(T)$, "gray body assumption".

Sources of systematic temperature error in the LHDAC explored include effects of: (1) the gray-body assumption, (2) differences as a function of sample preparation, and (3) the effects of the optical system. To investigate these potential sources of error, we analyze apparent temperature as a function of wavelength as well as use synthetic data to quantify the effects of iron $\varepsilon(\lambda,T)$ on temperature. We report the results of an analysis of 3,140 temperature measurements on iron collected at Argonne National Lab's Advanced Photon Source, at the beamlines HPCAT (16-ID-B) and GSECARS (13-ID-D), between 14-70 GPa and 1,000-2,900 K.

(1) We show with synthetic data that increasing emissivity as a function of wavelength results in a systematic underestimation of temperature, from 4% at 1000 K to over 10% at 2500 K. We find in our data that temperature generally decreases as a function of wavelength, consistent with an emissivity increase as a function of wavelength as is expected of iron. Further investigation is required to determine the source of the observed variation in temperature, which is likely caused by a combination of factors including but not limited to wavelength-dependent emissivity. (2) We find that foil iron samples have different trends in apparent temperatures as a function of wavelength than powder samples. We hypothesize that this could be due to the difference in surface properties or due to the emissivity response of other sample components besides iron. (3) We show with synthetic data that the difference between optical systems at HPCAT and GSECARS will cause a more severe underestimate of temperature by GSECARS. This prediction by synthetic data is reflected in our analysis of the apparent temperature as a function of wavelength of HPCAT and GSECARS data.

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I would like to thank Josh Martin, whose PhD project on the equation of state of iron motivated my study of iron's temperature in the diamond anvil cell. We collected our dataset at APS as a pair and he did all the scary stuff, like controlling the x-ray and lasers and putting the DAC up on the beamline. I want to thank him for teaching me so much, for his patience, and for always taking me to get all sorts of different yummy food when we visit the synchrotron.

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INTRODUCTION

Iron in the Earth's core

The Earth's core is 85-90% iron and nickel with 10-15% lighter elements (Wood et al., 2006; Fei et al., 2016). Since iron is the most important constituent of the core, in order to fully understand Earth, it is necessary to study iron at the extremely hot temperatures (4,000-6,000 K) and the high pressures (130-360 GPa) it experiences deep in the planet. Under the high-pressure and temperature conditions of the mantle and core, iron atoms form a hexagonal close-packed (hcp) lattice. Much experimental work has been done to understand density of hcp-iron at core conditions, but the equations of state (EsOS) that have been determined are mutually inconsistent, leading to large uncertainties of iron's density under core conditions (Figure 1). A precise high-pressure, high-temperature EOS would describe iron at core conditions and as such, it is the first step to identify the light elements in the core by revealing the core's exact density deficit.

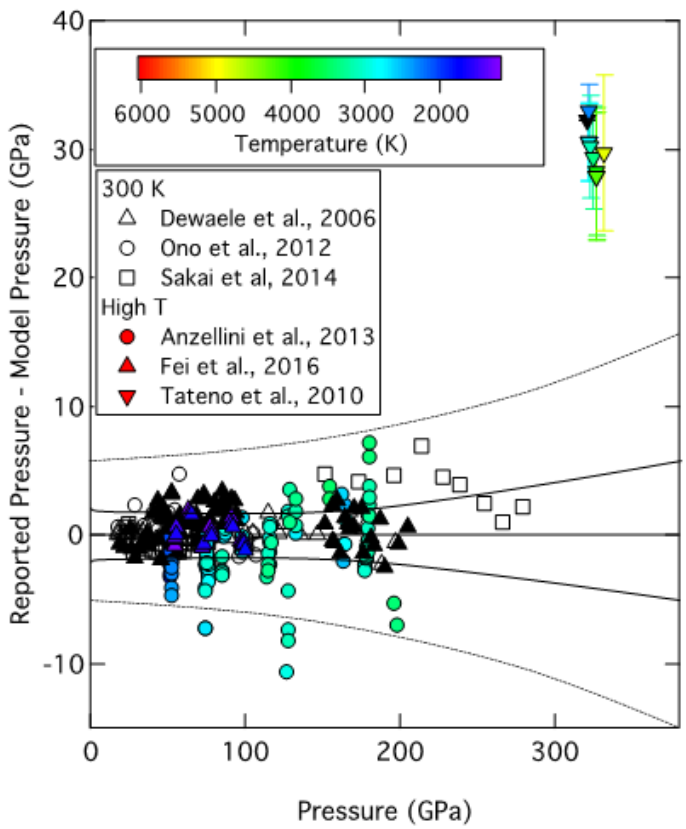


Figure 1. The difference in reported pressure from model pressure demonstrates the lack of precision in the equation of state of iron hcp-iron arising from the inconsistencies between EsOS.

A pressure, volume, temperature EOS predicts the properties of a material at a given depth in the Earth by relating the pressure (P), temperature (T), and volume (V) of the material (Angel, 2000). Knowing each P, V, and T component precisely is integral in a high-precision EOS, which will describe the behavior of a material at the extreme pressure and temperature conditions of the Earth's interior. Systematic errors in any measurements of P, V, or T will lead to systematic errors in inferred density of pure iron under core conditions. Such errors lead to systematic errors in estimates of core temperature and light-element composition. These, in turn, lead to errors in the Earth's thermal history and bulk composition.

The laser-heated diamond anvil cell (LHDAC) simulates the high-pressure, high-temperature conditions of minerals in the Earth's mantle and core and are widely used to study materials at extreme pressures and temperatures (Figure 2). The DAC generates the pressure (>100 gigapascals) in the deep Earth on a sample squeezed between two opposing diamond anvils. Infrared laser light passes through the diamonds and heats the sample to temperatures in excess of 3,000 Kelvin. Though the LHDAC is powerful, the extreme pressures of the core are not often attainable due to the limiting strength of the diamond anvils (see Figure 1 for typical P and T), and so P, V, and T data is extrapolated to core conditions for EsOS. Temperature in the LHDAC is determined with spectroradiometry, with the gray-body approximation of Planck's black-body radiation law, which relates the intensity (I) of light that the laser-heated sample emits while it's hot to the sample's temperature, the wavelength of the emitted light (λ), and the sample's emissivity, assuming emissivity is wavelength-independent ($\varepsilon(T)$, the "gray-body") (Heinz & Jeanloz, 1987, Heinz et al., 1991, Jeanloz & Kavner, 1996)

While being heated, the sample is simultaneously analyzed using x-ray diffraction, which reveals the composition and density (volume) of the sample at high pressure and temperature. Synchrotrons are facilities that generate the high energy x-rays used for x-ray diffraction. We gathered x-ray diffraction and laser-heating data at Argonne National Lab's Advanced Photon Source (APS) from two LHDAC beamlines: HPCAT (16-ID-B) and GSECARS (13-ID-D). In this thesis, I explore the details of how the temperature measurement is performed in these experiments as a step to address whether or not discrepancies in EsOS, such as those in Figure 1, may be explained by how the temperature data are collected or how the samples are prepared.

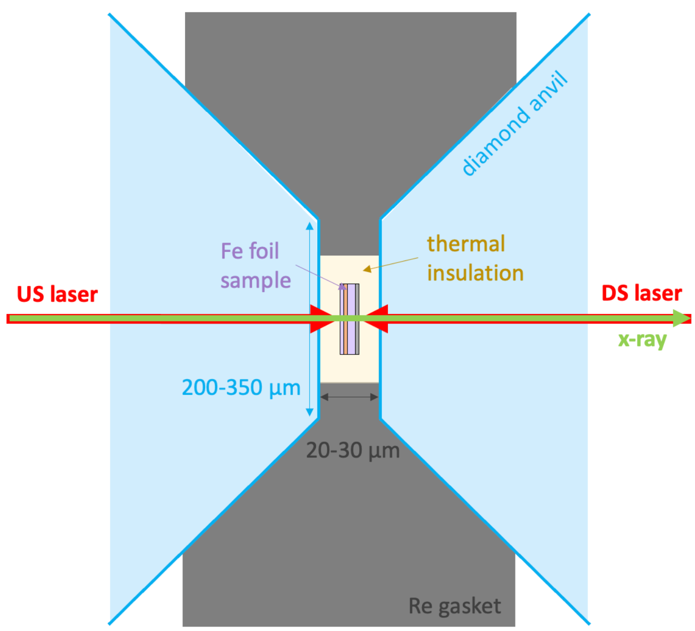


Figure 2. DAC cross-section showing a sample during simultaneous laser-heating and x-ray diffraction (not to scale).

Sources of systematic error in temperature

Wavelength-dependent emissivity

In the wavelength range in which we measure temperatures in the diamond anvil cell (~600-900 nm), there is a local increase in iron's emissivity (Touloukian & DeWitt, 1970, Wanatabe et al., 2003). The assumption of wavelength-independent emissivity when fitting temperature measurements from LHDAC experiments could thus contribute to the inconsistent EOS of iron by skewing temperature in those approaches that assume constant emissivity, such as the gray-body approximation of Planck's law. We hypothesize that the use of the gray-body approximation of Planck's law to estimate the temperatures of iron samples, which have wavelength-dependent emissivity, causes a systematic error in temperatures estimated, with an impact on the EOS of iron under core conditions. Based on the results of Touloukian & DeWitt (1970) and Wanatabe et al. (2003), we would expect an increase in emissivity across the wavelength range ~600-900 nm, which would result in a systematic underestimate of temperature due to the gray-body approximation of Planck's law. We will use two-color pyrometry (Kavner & Panero, 2004) to quantify how temperature changes as a function of wavelength and compare these results to models of increasing emissivity.

Effect of sample preparation

We introduce microfabricated iron foil samples with precise chemical makeup as a way to standardize experimental study of iron. Because most published hcp-iron EsOS have used samples consisting of iron powder (e.g. the work on Figure 1), we also gathered data from iron powder in order to compare if the foil samples and the powder samples have different responses when laser heating. We hypothesize that there is a quantifiable difference in temperature measurements arising from samples as a function of how they are prepared (foil vs powder). Specifically, emissivity of a material can be affected by the material's surface features (i.e. shininess, oxidation, sample components besides iron) (Jo et al., 2017). As above, we will use two-color pyrometry to address this hypothesis by measuring separately how temperature data from foil and powder samples varies as a function of wavelength.

Effect of optical system

Systematic differences in temperature measurements between laser heating facilities could also contribute to the variable EOS of iron. An in-depth study of the key differences between the temperature measurement systems at HPCAT and GSECARS may encourage standardization of the way we measure experimental temperature in the LHDAC. Understanding the differences that arise from various techniques of temperature fitting and making an effort to standardize temperature determination techniques will not only more realistically constrain the EOS of iron, but benefit every LHDAC user by making our experiments more accurate and thus more applicable to real planetary interiors. The CCD cameras used for temperature measurement and the code written to automatically interpret the spectral intensity data into a temperature are key components that differ between beamlines (i.e. wavelength range used to measure temperature, CCD rotation, background light subtraction, etc.). Such variation may result in a difference in the temperature estimated from the same laser heating intensity measurement and limit reproducibility of the temperatures estimated by a beamline's code. We hypothesize that in the case of samples with wavelength-dependent emissivity, there is a quantifiable difference between temperature measurements between beamlines. We will quantify this difference by comparing the variation in temperature with wavelength returned by two-color pyrometry of each beamline and of each wavelength range that the beamlines use. We will compare these results to those predicted by synthetic data for different measured wavelength ranges.

METHODS

Experiment design

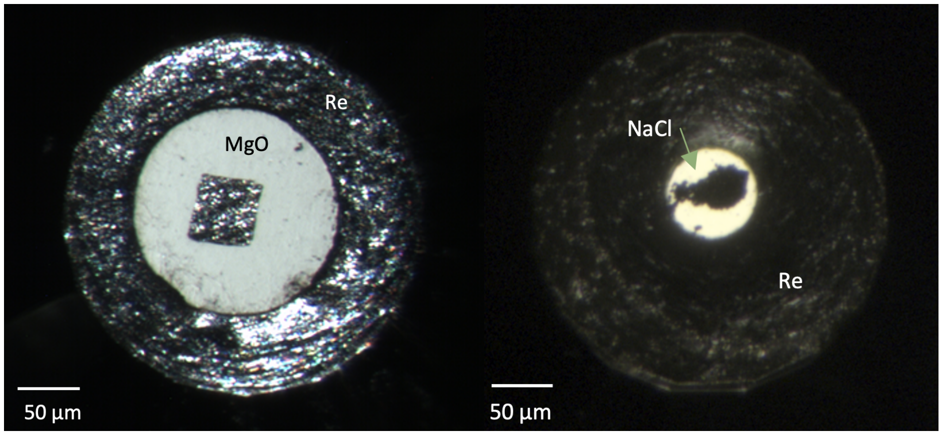


Figure 3. Samples in the gasket chamber, seen through the diamond anvil. Left, microfabricated foil sample. Right, pressed powder sample.

Microfabricated foil samples were made at Nanotech West at Ohio State University by evaporation and sputter deposition of materials into nanocrystalline layers, resulting in a foil <2 µm thick with precise chemical makeup (Figure 3, left). The metallic foil is etched into hundreds of 50x50 µm samples. The foil samples are designed to minimize axial and radial temperature gradients and to standardize sample geometry and composition, as opposed to powder samples, which have inconsistent geometry, composition, and often have extreme internal temperature gradients. A schematic for our first foil sample is shown in Figure 4 (top) and contains 4 layers: SiO_2, Fe, SiO_2, and Pt. The top layer of SiO_2 protects the Fe from oxidation and the layer of SiO_2 between the Fe and Pt prevents the metals from alloying. The Pt serves as an internal pressure standard. The second foil sample design is shown in Figure 4 (bottom) and contains 5 alternating layers: MgO, Fe, MgO, Fe, MgO. MgO is the internal pressure standard. For the June 2019 runs, the foil samples (both the Pt and MgO designs) were loaded between NaCl plates as thermal insulation. The MgO microfabricated foil samples were only used in the June 2019 experiments. In June 2019, we found that NaCl tore the foil samples, so after these runs, we used MgO plates, which are stiffer and less likely to tear the foils.

Powder samples consist of a mechanical mixture of a ~1:1 ratio of Fe powder to MgO powder (the internal pressure standard) dried under ethanol and pressed into a plate, loaded between NaCl plates as thermal insulation (Figure 3, right). Both sample designs were loaded into precompressed 20-30 µm Re gaskets in DACs with culets ranging 200-350 µm. In Table 1, our datasets are shown with the following information: experiment location (HPCAT 16-ID-B or GSECARS 13-ID-D), the number of temperature measurements off of foil samples, the number of temperature measurements off of powder samples, and finally the pressure ranges of our samples.

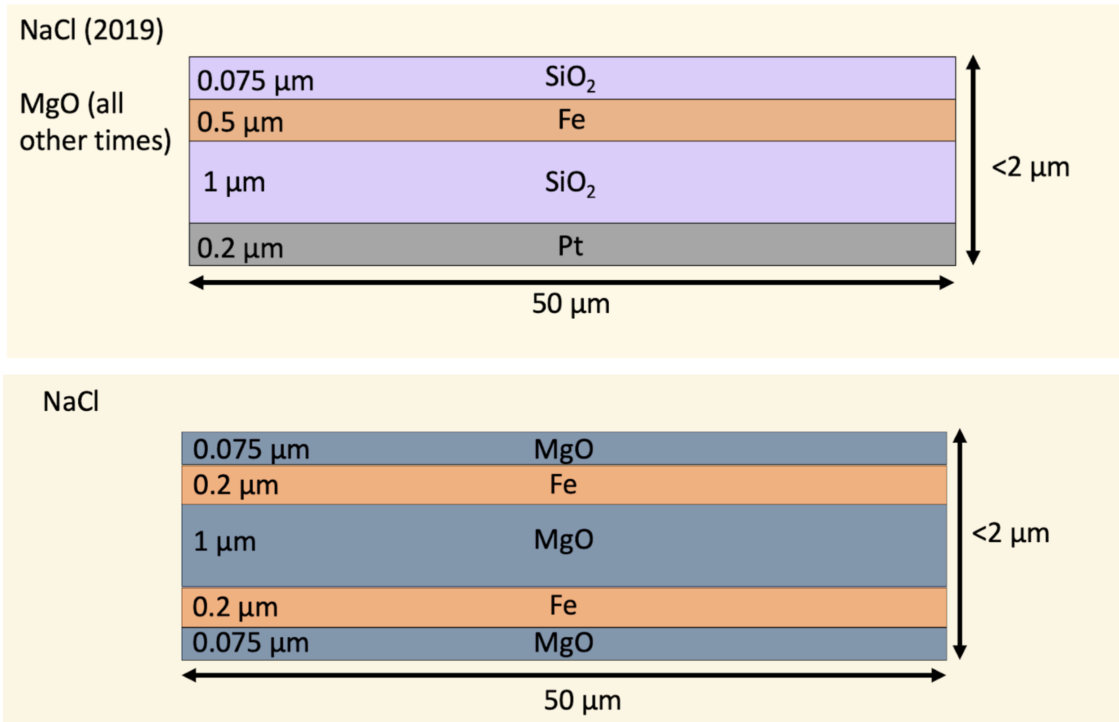


Figure 4. Cross-sectional view of sample designs (not to scale). Top, Pt microfabricated foil; bottom, MgO microfabricated foil. All samples are loaded in a thermal insulating medium consisting of plates of salt (MgO or NaCl) and were loaded into Re gaskets with a pre-indented hole 20-30 µm thick.

Beamline and Experiment Date	*# of foil T measurements*	*# of powder T measurements*	*Pressure range*
HPCAT 16-ID-B 06/19	702 (Pt and MgO foils, loaded in NaCl)	98 (Fe/MgO powder mixture, loaded in NaCl)	14-60 GPa
GSECARS 13-ID-D 02/20	214 (Pt foils, loaded in MgO)	176 (Fe/MgO powder mixture, loaded in NaCl)	60-70 GPa
HPCAT 16-ID-B 03/20	856 (Pt foils, loaded in MgO)	124 (Fe/MgO powder mixture, loaded in NaCl)	25-70 GPa
HPCAT 16-ID-B 10/10/20	372 (Pt foils, loaded in MgO)	156 (Fe/MgO powder mixture, loaded in NaCl)	56-70 GPa
HPCAT 16-ID-B 10/24/20	None	442 (Fe/MgO powder mixture, loaded in NaCl)	30-40 GPa

Table 1. The datasets used in this analysis.

Data analysis

Data collection

At the beamline, the DAC is placed such that the x-ray and the two heating lasers pass through the transparent diamonds and into the sample between the diamonds' tips. 1064 nm infrared lasers heat the sample chamber of the DAC continuously from the upstream (US) and downstream (DS) sides of the DAC (Figure 2), resulting in two separate temperatures from each side of the sample with the goal of maintaining the two opaque sides of the sample at the same temperature so that the intervening material is also at the same temperature. The upstream and downstream lasers are placed out of the way of the x-ray's path and are guided to the sample with x-ray transparent mirrors. As the sample is laser heated, the light from the hot sample travels from the sample chamber, through the anvils, and through the optical system to a detector (the "chip" that we visualize the data with in Figure 6), which images the intensity of the brightness of the hot, glowing sample as a function of the wavelength of emitted light. This imaged light can then be understood with spectroradiometry.

Temperature from laser heating in DACs is measured with spectroradiometry: a measurement of the intensity of light emitted from the hot sample surface with a CCD detector and spectrograph during heating. The temperature indicated by the spectroradiometric data is determined using Planck's black-body radiation law, which describes how a material emits light when it's hot, as the sun or molten lava glow due to their high temperature. Planck's law of black-body radiation relates the measured intensity (I) of light emitted from the sample to the sample's temperature (T) and emissivity (ε) as a function of the wavelength of the emitted light (λ):

$$I(\lambda, T) = 2\varepsilon(\lambda, T)\pi hc^2\lambda^{-5}[\exp\left(\frac{hc}{\lambda kT}\right) - 1]^{-1}$$

equation 1.

Where h is Planck's constant, c the speed of light, and k Boltzmann's constant. The gray-body approximation of Planck's law assumes wavelength-independent emissivity, $\varepsilon(T)$, and is a common simplifying assumption when fitting temperature from laser-heating data. Spectroradiometric intensity is imaged in the visible and near-infrared wavelengths (generally 500-1000 nm) because longer wavelengths will include the laser light itself (1064 nm). In the mid-infrared, the absorptive properties of the diamonds become significant. It cannot be measured at any shorter wavelengths because emitted intensity is insufficient in the wavelengths in the blue to yellow portion of the spectrum. Both beamlines fit temperatures with the gray-body approximation of Planck's law; HPCAT measures temperature from 600 to 800 nm and GSECARS measures temperature from 666-836 nm (Figure 5).

Emissivity of materials is known to change as a function of wavelength, such that the gray-body assumption of Planck's law is an inherent source of systematic error when determining temperature in the LHDAC. Kavner & Panero (2004) show with synthetic intensity data that an emissivity decrease of 30% results in a temperature overestimate of 170 K when the true temperature is 2,500 K (apparent T>real T).

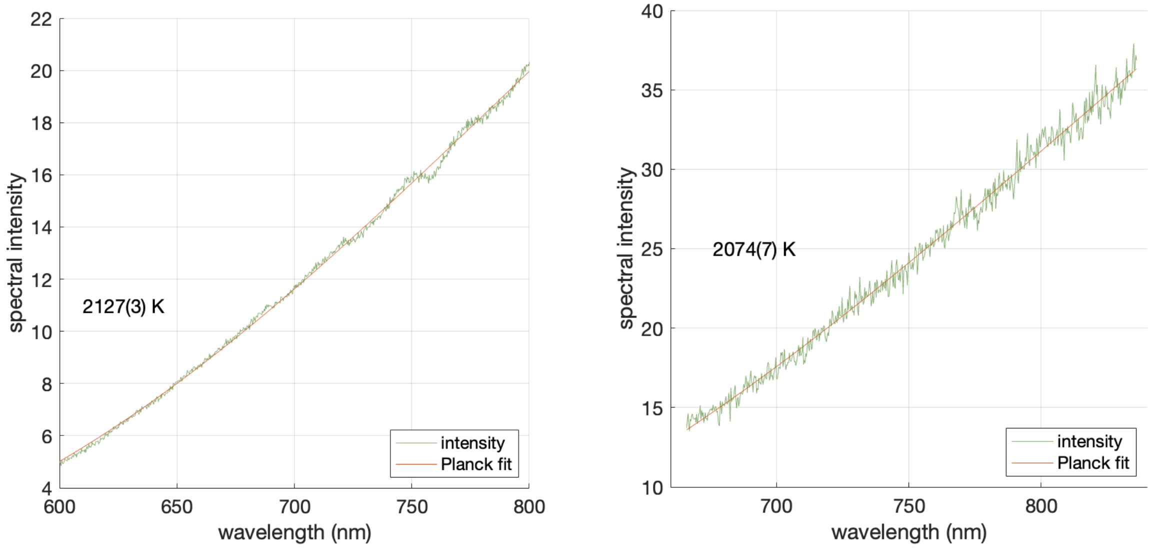


Figure 5. Spectral intensity as a function of wavelength, with corresponding Planck fits overlain. Data from a foil at HPCAT (left) and a powder sample at GSECARS (right). Note the different wavelength ranges over which the intensity is measured.

Data calibration

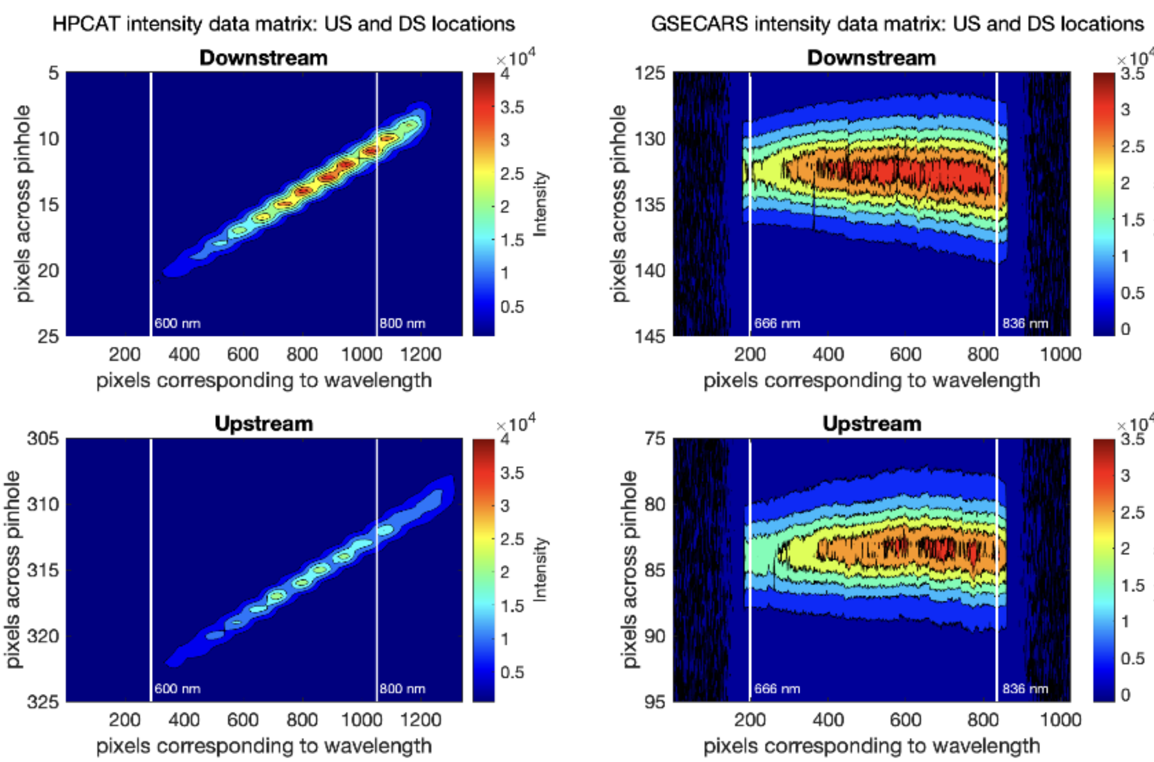


Figure 6. Two similar temperature measurements from each beamline shown as a contour plot of intensity data on the chip. White bars show the pixels that correspond to the wavelength range with which temperature is determined by the beamline's system: 600 to 800 nm for HPCAT and 666 to 836 nm for GSECARS.

Intensity data from the CCD detector is collected as a single matrix containing the separate but simultaneous US and DS measurements each time emitted light is imaged with the CCD and spectrograph. The *T* data must be corrected to account for background light and the wavelength-dependent response of the optical system before it is fit for a temperature with Planck's law. Data for US and DS spans across several rows of the chip, each side separated by rows of background-level intensity (see Figure 6). The first step taken to calibrate intensity data is to sum the US and DS rows into single rows so that all data is contained in a row. Next, background light must be subtracted. Data from GSECARS is auto-background subtracted when given to the user, and we found little correlation between the background-level data and exposure time, so no further background correction is done for this data. HPCAT data is not background subtracted and shows correlation between the magnitude of spectral intensity and the exposure time of the laser heating measurement.

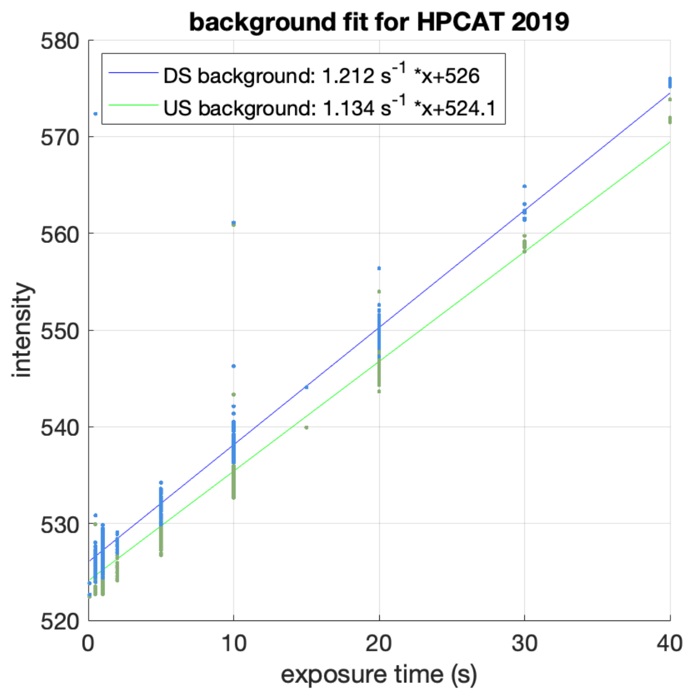


Figure 7. An example of a straight line fit to background level data from one dataset, HPCAT 2019. Background level light increases with exposure time corresponding to the longer time that the detector collects light for each measurement. Each dataset is fit with its own background.

To subtract the background from HPCAT data, 30 data rows near the matrix location of US and 30 data rows near the matrix location of DS intensity data are averaged for every laser heating measurement. We find that background-level intensity increases with exposure time. With a least-squares straight line fit to near-US and near-DS mean intensity data, we quantitatively define the relationship between background and exposure time for each HPCAT dataset (Figure 7). We can then subtract the mean background intensity as a function of the exposure time of the measurement, normalized to the exposure time of the temperature calibration measurement taken prior to laser heating.

The system response must be accounted for in measurements from both beamlines. System response is the wavelength-dependent throughput of the optical system. Calibration measurements are taken by measuring the spectral intensity of special lamps (tungsten filament lamps for both HPCAT and GSECARS). The lamps have known, standardized spectral radiance, so that the known response of the lamp can be compared to the output of the system. By taking a measurement of the lamplight and comparing the system's output to what should have been output, the response of the system can be quantified. System response data is calibrated similarly to laser heating data: the data is summed across the US and DS rows so that US and DS are each in a single row, the US and DS specific background is subtracted in HPCAT data, and finally, the data is divided by the known response of the lamp as a function of wavelength. The final step before having a response-corrected spectrum is dividing the measured thermal emission data by the system response function. This described calibration process well reproduces temperatures measured by the beamlines' systems.

Assessing temperature fit accuracy: two-color pyrometry

Wein's approximation of Planck's law is valid for low temperature, when $\exp\left(\frac{hc}{\lambda kT}\right) \gg 1$:

$$I(\lambda, T) = 2\varepsilon(\lambda, T)\pi hc^2\lambda^{-5}\left[e^{hc/\lambda kT}\right] \quad \textit{equation 2.}$$

Kavner & Panero (2004) show that the error introduced by Wein's approximation is less than 0.2% below 3500 K, which is well above the temperatures in our dataset. With Wein's approximation, Planck's law is linearized:

$$J = \ln\left(2\pi hc^2\varepsilon(\lambda, T)\right) + \ \omega * \frac{1}{T}\ ;\ J = \ln(I(\lambda, T)\lambda^5)\,, \omega = -\frac{hc}{\lambda k} \quad \textit{equation 3.}$$

Where J is the normalized intensity and ω is normalized frequency. The temperature is then determined as the inverse of the slope of $J(\omega)$. Two-color pyrometry uses the normalized intensity and frequency from Wein's approximation to produce a range of temperature from the same intensity measurement by sliding across a fixed spectral window, ω_1 to ω_2:

$$T = \frac{\omega_2 - \omega_1}{J(\omega_2) - J(\omega_1)} \quad \textit{equation 4.}$$

In terms of wavelength, the spectral window we use universally is approximately 50 nm. With the two-color technique, a series of Planck temperatures is calculated by connecting individual point pairs of intensity, from the intensity at ω_1 to that at ω_2 (Figures 8, 9). If a measurement is not skewed by external factors, including sample emissivity, noise, incomplete background subtraction, or improper system response calibration, then wavelength will not affect the inferred temperature and the resulting range of temperatures for an intensity measurement is constant as the spectral window slides across the intensity data, as in the constant emissivity synthetic two-color temperatures (Figure 11). If inferred temperature varies as a function of wavelength and there is a sloping structure in the two-color temperatures of an intensity measurement, it may be caused by wavelength-dependent emissivity of the sample, calibration error (incomplete subtraction of background; improper system response calibration), or noise. In this study, we quantify the variation of two-color temperatures with wavelength by measuring the change in temperature with wavelength, $dT/d\lambda$, with a least-squares linear fit to the two-color temperatures. We compare the error determined by the gray-body Planck curve fit to the uncertainty in the Wein temperature, which is determined by the standard deviation of the two-color temperatures (Figures 8, 9).

Noise is accounted for in two ways, both of which attempt to address non-physical predictions by two-color pyrometry and to remove nonphysical outliers in our data. When the intensity signal is low from a certain measurement, the calibration process of the emitted light results in negative intensity values (specifically, from overcorrection for background light). Temperature measurements with intensity sufficiently low to result in negative values following calibration are not considered in the two-color analysis if more than 10 (out of 700+ intensity data in a single measurement) are negative following calibration. In this way, we exclude data that counts too low for a trustworthy estimation of temperature. Second, if a two-color fit results in temperatures greater than 10,000 K (a temperature that would melt the diamonds) or less than 0 K (not physical), the data are discarded.

By analyzing trends in dT/dλ based on sample type, beamline, and temperature, we can understand how temperatures vary as a function of wavelength. Examples of intensity as a function of wavelength and corresponding two-color temperatures are shown in Figures 8 and 9. The fits were done with HPCAT data, but with both the wavelength range of HPCAT and with that of GSECARS. Any exercise where other wavelength ranges are explored within a single intensity measurement may only be done with HPCAT data, as GSECARS intensity data is given to the user filtered so that only intensities from λ=666-836 nm are included.

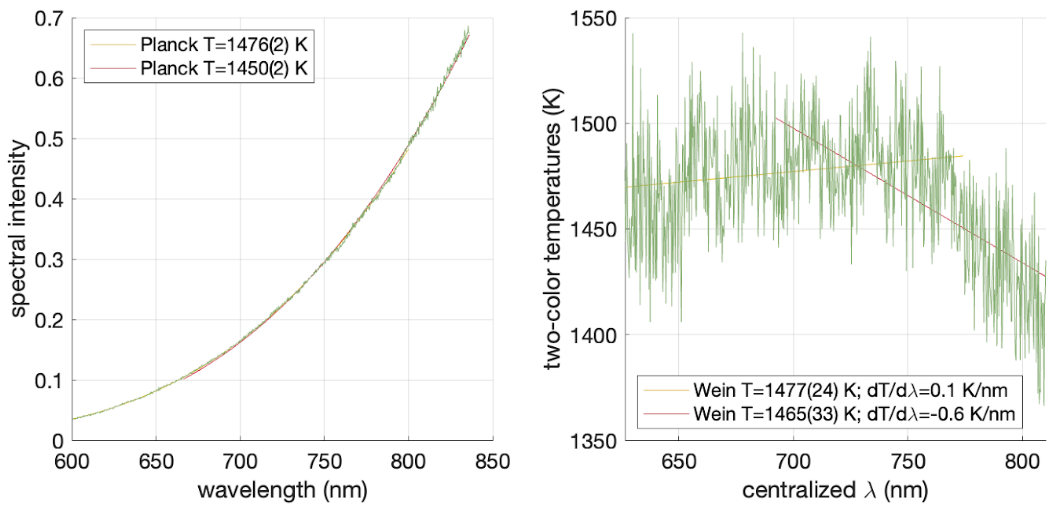


Figure 8. Planck fit and two-color temperatures for a foil sample. The gold curves are fit from 600-800 nm while the scarlet are fit from 666-836 nm. The Planck fits are excellent and a statistical curve fit estimates error in T as +/- 2 K. Two-color pyrometry shows minimal variation over wavelength, especially for the lower wavelength range (gold, HPCAT). The Wein Ts are similar to Planck, but with more significant error.

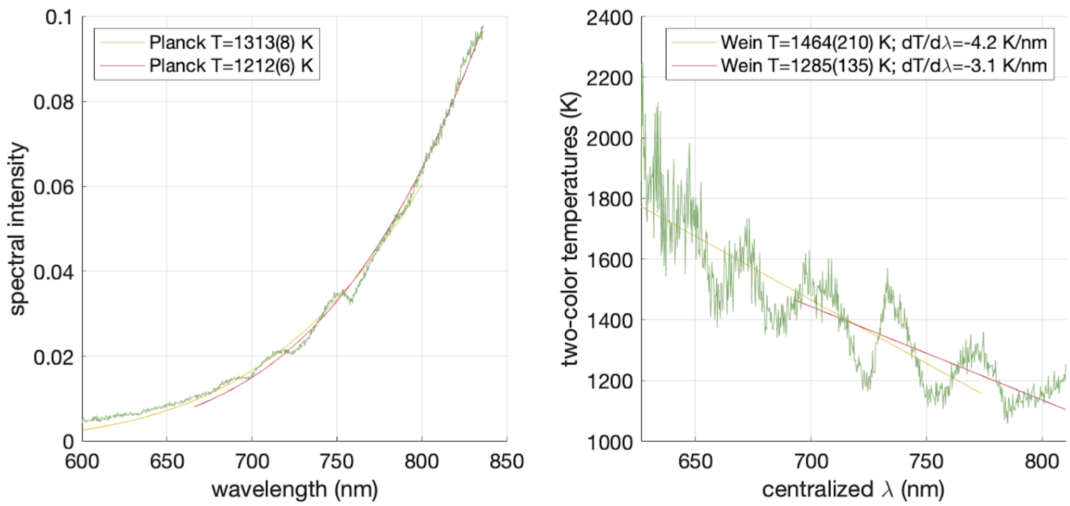


Figure 9. A low intensity data with an ill-fit Planck curve demonstrating the possibility for strong dependence on wavelength of temperature and resulting large uncertainties (100s of Kelvin) from two color pyrometry. The gold curves are fit from 600-800 nm while the scarlet are fit from 666-836 nm.

RESULTS

Typical gray-body Planck curve fitting, as is done at both HPCAT and GSECARS, return errors that only consider statistical uncertainty in the curve fit, which is the uncertainty shown in the Planck temperatures on Figures 8 and 9. However, even well fit data, with small dT/dλ, show that error may be underestimated when only considering statistical error from Planck fitting. Two-color temperatures even for excellent fits show variation that results in more significant error (Figure 8). Intensity measurements which result in badly fit Planck curves, such as that in Figure 9, result in significantly larger variation in two color temperatures (larger dT/dλ), and ultimately in a poorer constraint on temperature for these measurements.

Synthetic datasets were used to simulate the effects of increasing emissivity of iron over the spectroradiometric wavelength ranges of HPCAT and GSECARS. Figure 10 shows that an emissivity increase of ~20% (i.e. Wanatabe et al., 2003) results in a systematic underestimate of temperature and negative dT/dλ across the two-color temperatures. Important takeaways are that dT/dλ increases with true temperature and that measuring over higher wavelengths (GSECARS) results in more severely underestimated temperatures compared to true temperature than over lower wavelengths (HPCAT). This is reflected both in the synthetic data (Figure 10 (left)) and in the examples provided of real data, where we do not know true temperature, but do see that temperature measured with a higher wavelength range is colder than at the lower wavelength range (Figures 8 and 9).

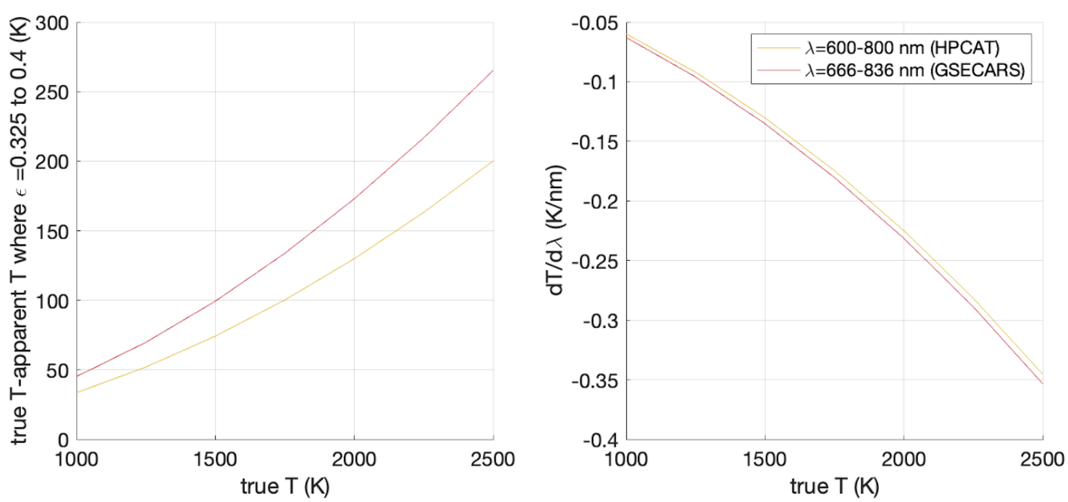


Figure 10. Synthetic data where emissivity is varying from 0.325-0.4 (i.e. Wanatabe et al., 2003), calculated with the wavelength ranges of HPCAT (gold) and GSECARS (scarlet). Left: difference of true T and T where emissivity decreases linearly with wavelength, as a function of the true temperature. Right: dT/dλ of the two-color temperatures, as a function of true temperature.

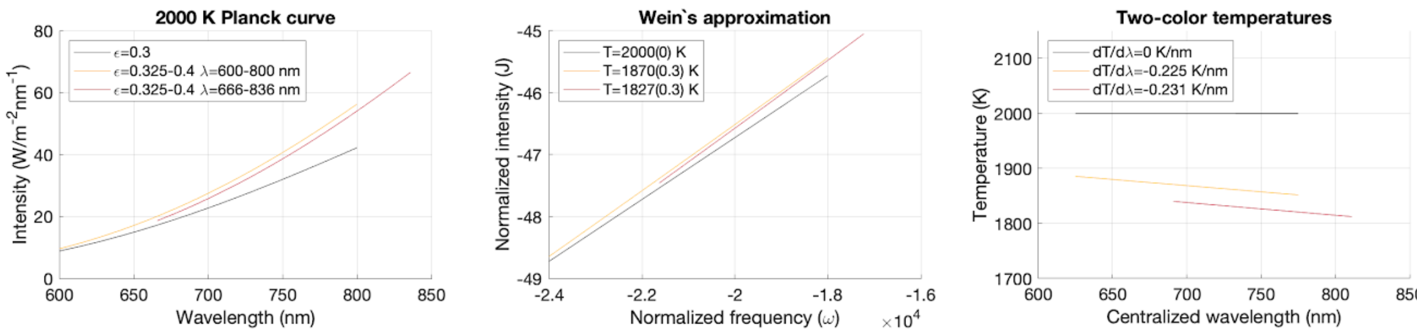


Figure 11. Planck, Wein, and two-color pyrometry results for synthetic data at 2000 K. The black curve on each plot represents a blackbody (constant emissivity) while the gold and scarlet curves are calculated with increasing emissivity and HPCAT's and GSECARS' wavelength ranges, respectively.

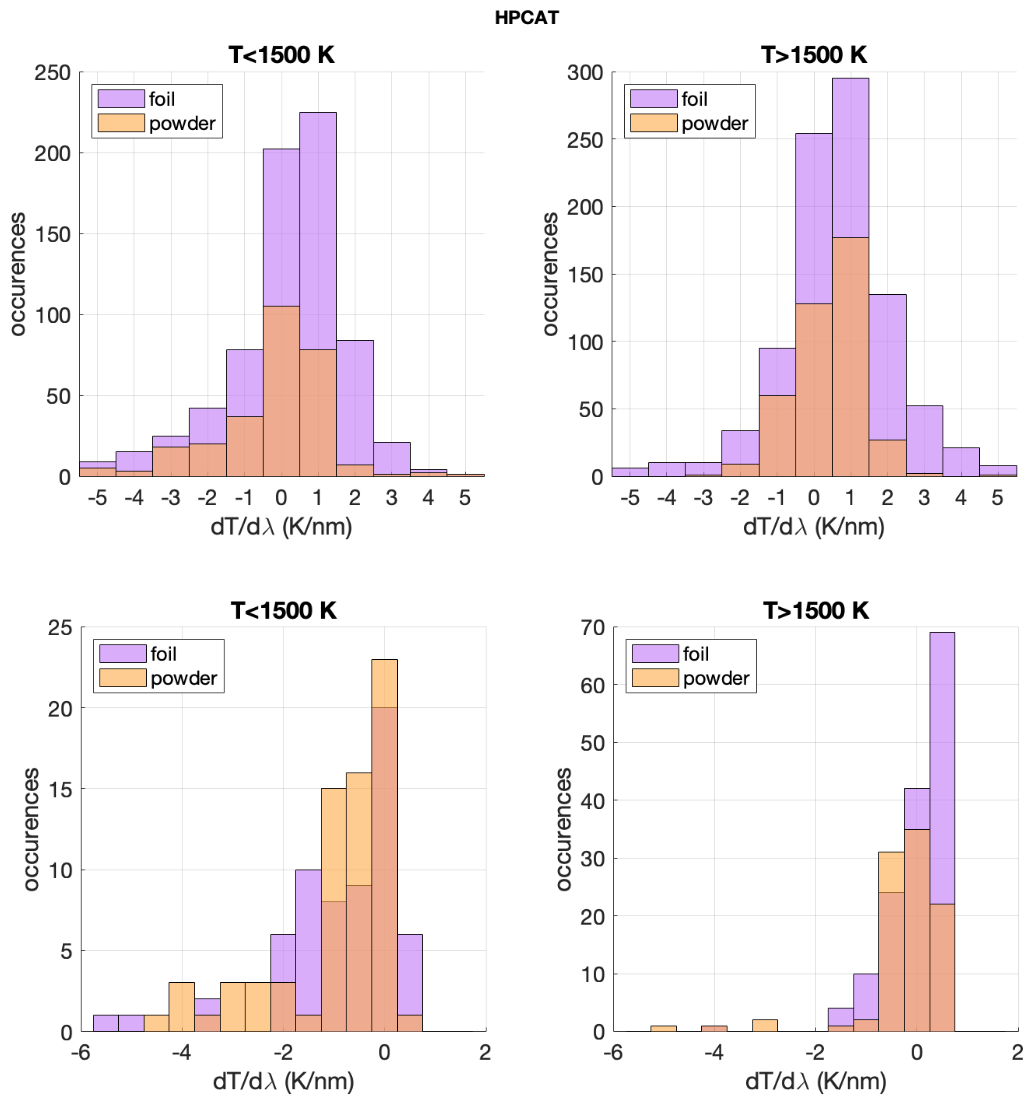
Table 2 shows the mean dT/dλ for our iron data. It is organized by sample type (foil and powder), dataset (HPCAT, Table 2a and GSECARS, Table 2b), and temperature (less than and greater than 1500 K, determined by Planck fits). Number of occurrences and standard deviation are provided to portray the significance of the data subset and the value of the mean. Figure 12 visualizes this data with histograms. We can compare what we expect from synthetic data to what we observe in real data to begin answering our research hypotheses.

a. **HPCAT data** T<1500 K	**# of occurrences**	**Mean dT/dλ (K/nm)**	**Stdev of dT/dλ (K/nm)**
Powder	293	-0.9370	3.7496
Foil	755	-0.7866	4.9015
All	1048	-0.8286	4.6073
HPCAT data T>1500 K	**# of occurrences**	**Mean dT/dλ (K/nm)**	**Stdev of dT/dλ (K/nm)**
Powder	412	-0.1234	6.9985
Foil	951	0.1554	4.1683
All	1363	0.0711	5.1880

b. **GSECARS data** T<1500 K	**# of occurrences**	**Mean dT/dλ (K/nm)**	**Stdev of dT/dλ (K/nm)**
Powder	75	-1.9201	5.5869
Foil	63	-0.8716	1.2158

All	138	-1.4415	4.2194
GSECARS data T>1500 K	**# of occurrences**	**Mean dT/dλ (K/nm)**	**Stdev of dT/dλ (K/nm)**
Powder	97	-0.6035	2.5389
Foil	150	0.0031	0.5950
All	247	-0.2351	1.6787

Table 2. dT/dλ results for our data, by beamline, temperature, and sample type.



a.

b.

Figure 12. Histograms showing trends in dT/dλ at low and high temperature. (a.) HPCAT data; (b.) GSECARS data. The data is split by temperature (left, T<1500 K; right, T>1500 K) and by sample type (purple, foil; orange, powder).

In almost all of the data, dT/dλ is mean negative. The exception to this trend is in high-temperature foil samples for both HPCAT and GSECARS; the change in trend from mean negative to mean positive is clear in Figure 12 when comparing measurements made on foils at low temperature to those at high temperature. Powder samples maintain mean negative dT/dλ at low and high temperature, but dT/dλ is less negative at high temperature. Overall, powder samples have stronger slopes than foil.

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Discussion

Sources of systematic error in temperature

Wavelength dependent emissivity

Synthetic models of wavelength-dependent emissivity predict negative $dT/d\lambda$ when emissivity increases as a function of wavelength, as is expected for iron. Indeed, our observed $dT/d\lambda$ is dominantly negative, but unlike in synthetic data, where $dT/d\lambda$ becomes more negative with higher temperatures, we observe the opposite: lower temperature data has more extreme slopes in their two-color temperatures, and higher temperature data has smaller slopes, even positive, especially for high temperature foil samples.

Two-color pyrometry is not only sensitive to wavelength-dependent emissivity; it also amplifies calibration error and noise. While extreme cases of noise are easily accounted for and excluded from our two-color analysis (i.e. negative intensity following calibration and non-physical temperatures, as discussed in methods) it is possible and likely that low intensity measurements are still affected by noise and that this effect is why we observe more extreme $dT/d\lambda$ in low temperature, contrary to the prediction of our synthetic data. These low intensity, low temperature ($I(T)$) data are exemplified in Figure 9.

System response at HPCAT is known to be infrequently updated (at least in 2020) with six months or more in between measurements of the calibration lamp. Questions as to the frequency of calibration at GSECARS have not been answered. Outdated calibration may introduce error into the data by making a complete correction for the throughput of the optical system impossible, as miniscule changes in the area of the laser may change the system's throughput. Outdated system responses make it even more difficult to isolate effects of the material, such as wavelength-dependent emissivity, from effects of the optical system.

Effect of sample preparation

We observe a difference between the trends in $dT/d\lambda$ of foil samples compared to powder, which is especially evident in the mean $dT/d\lambda$ for foils compared to powder (generally, powder $dT/d\lambda$>foil $dT/d\lambda$). The histograms in Figure 12 show the same as the mean $dT/d\lambda$: that change in temperature with wavelength is more strongly negative in powder samples, while foil samples have many more positive $dT/d\lambda$, even resulting in positive high temperature foil mean $dT/d\lambda$. The apparently more common positive $dT/d\lambda$ which results from temperature measurements off of foil samples shows that there is a difference in temperature measurements as a function of sample preparation.

Effect of optical system

Synthetic data modelling iron's increasing emissivity with wavelength shows that inferred temperature changes based on wavelength range. Because emissivity of iron does change, even if we cannot quantify it as distinct from system and data processing effects at this time, these synthetic data show that wavelength range matters when measuring temperatures off of samples where emissivity changes: underestimation is exacerbated in synthetic data when wavelength range is higher. Synthetic data also suggests that $dT/d\lambda$ will be more negative over higher wavelength range. In real data, higher wavelength range results in lower estimated temperature (Figures 8 and 9) and, as synthetic data predicts, the mean $dT/d\lambda$ of GSECARS is more negative than that of HPCAT.

CONCLUSIONS

In our investigation, we showed that temperature is wavelength dependent in the spectroradiometric data from iron samples gathered at HPCAT (16-ID-B) and GSECARS (13-ID-D). This fact is not accounted for in the statistical curve fit uncertainties returned at most beamlines. Temperature cannot be taken at face value from a Planck fit, especially when intensity is low or when the Planck curve fit to the intensity data as a function of wavelength is badly fit. These misleadingly small uncertainties in temperature most certainly affect iron EOS data because in reality, uncertainty in temperature is larger, and this is not being accounted for in the EOS calculations. In fact, all data which relies on temperatures determined with spectroradiometry that only consider Planck's gray-body approximation and associated statistical curve fit error have the potential to contain misleading conclusions because high precision of temperature is being wrongly assumed.

More work needs to be done to distinguish emissivity from other effects that cause temperature to be wavelength dependent. The way we may further address noise-dominated data to isolate emissivity effects is discussed in the recommendations for future work section. We do observe a difference in wavelength-dependent temperature between foil and powder samples: foil samples tend to have more positive $dT/d\lambda$ than powders. An investigation as to why this is the case (surface emissivity difference, other sample components) should be done and is discussed below as well.

Perhaps the most conclusive statement we can make at this time is that of the effect of the optical system, particularly the wavelength range over which temperature is determined. First, we quantify this in our synthetic data, where we show that intensity data from a material with increasing emissivity will result in a larger underestimate in temperature when the wavelength range is higher. In agreement with our synthetic data, we show with HPCAT data, where we have access to wavelength from ~580-850 nm (as opposed to GSECARS, where the user is only given wavelength 666-836), that temperatures fit for the same intensity measurement over higher wavelength are lower at higher wavelength ranges (Figures 8 and 9). We show that $dT/d\lambda$ is more strongly negative in GSECARS data than in HPCAT data, where temperature is measured over a higher wavelength range (Figure 12, Table 2). Overall, it is clear that when unavoidable factors affect spectroradiometric data, such as wavelength-dependent emissivity and noise dominating at short wavelengths (in the visible), the wavelength range you choose to determine temperature from will affect what temperature is determined. Higher wavelength ranges may result in a more significant deviation from true temperature than lower wavelength ranges.

Based on results from Figures 10 and 11, at 2500 K, measuring from 600-800 nm underestimates true temperature by 8%, while measuring from 666-836 nm underestimates true temperature by 11%. We can estimate the resulting error in the density of pure iron in the core caused by a conservative 10% underestimate in core temperature with one of Maxwell's relations (Poirier, 2000):

$$\left(\frac{\partial V}{\partial T}\right)_{P} = \alpha V$$

equation 5.

Where the thermal expansion coefficient α is 10^{-6} K^{-1} and the core temperature is 6000 K (∂T = -600 K). Solving for $1/V\, \partial V$ shows that volume will be underestimated by 0.06%, which results in a 0.06% overestimate in density. While a 0.06% overestimate may not seem significant when collected under core conditions, this does not include the error that arises from extrapolation of pressure or temperature, or from errors (systematic or otherwise) in volume and pressure determination. The effects of extrapolation are the subject of a separate study.

Recommendations for Future Work

The wide standard deviations for HPCAT data in Table 2a and the overall lack of distinction between the low and high temperature histograms for HPCAT in Figure 12a suggest that the temperature dependence of $dT/d\lambda$ may not be as simple as it is being portrayed as. A statistical examination to determine if the low and high temperature populations are different should be done in order to determine if there is temperature dependence in HPCAT data. In addition, a more rigorous examination of outlying data should be undertaken. For example, there are intensity measurements within our datasets which result in $dT/d\lambda$ of more than -10 K/nm which skew our data towards the negative. We can make an educated guess that these dramatic slopes result from low intensity, noise-dominated data and thus should not be included. However, a systematic quantification of what kind of data results in these outliers should be done (it is possible that these result from saturated data, for example). This may allow us to eliminate more improbable data and "solve" the problem of wide standard deviations, especially in HPCAT data, to understand further the temperature dependence (or lack of temperature dependence) in $dT/d\lambda$. We also have reason to believe, through synthetic data analysis, that dramatic slopes may result from under-subtraction of background at short wavelengths. In summary, more work needs to be done to further account for noise-dominated or otherwise "bad" data; in doing so we may more reliably constrain whether we are observing emissivity effects by suppressing the other factors which introduce variation in two-color temperatures, such as noise.

We need to investigate the source of the $dT/d\lambda$ discrepancy between foil and powder samples. We hope to determine in the future if the observed effect is a surface effect or if it is a result of an emissivity response by another material in the foil samples, especially Pt in the Pt foil samples. The emissivity response of Pt as a component in our iron foils is of particular interest because it is known to have decreasing emissivity with wavelength in the near-infrared, opposite to the expected response by iron (Deemyad & Silvera, 2008).

Our results from synthetic data in Figure 10 show that lower wavelength ranges (600-800 nm) result in less deviation from true temperature. We could argue based on these results that it is best to measure over lower wavelength ranges, since emissivity does vary as a function of wavelength in real materials; however, since changing emissivity is not the only factor affecting temperature in real data, more work should be done to decide this (models may be built to incorporate noise, under-subtraction of background, detector saturation, etc.).

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Appendix

Notes on data: if T=300 (from the beamline) that's because the system thought it was too dark to take a measurement. If dT/dλ is NaN, that's because the fit had a y-intercept >10,000 K, <0 K, or had more than 10/~700 negative intensity values. For each dataset, the data is listed and below it, the pressures and sample type are listed for each T file. The sample types are "mix," which refers to the mechanical MgO/Fe powder mixtures; "Pt foil", the microfabricated foils with Fe, Pt and SiO_2; and "MgO" foil, the microfabricated foils with Fe and MgO.

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File	log US T	log DS T	my US fit	my DS fit	dT/dλ US	dT/dλ DS
1	0	0	1246.36772	1247.93131	NaN	0.0074513
2	300	300	1736.88094	1978.58853	NaN	NaN
3	1512.08217	1322.21053	1472.96282	1339.38627	-2.6428474	-3.3116472
4	1823.55302	1536.93844	1827.71077	1540.56598	-0.4331842	-1.53999
5	1860.18705	1560.59051	1865.46147	1612.79688	0.19084004	0.49019791
6	1840.77231	1520.2002	1841.21617	1522.37936	-0.1758956	-0.8122687
7	1972.03665	1673.59069	1974.8231	1678.0068	-0.5209015	-0.4590304
8	2119.05381	1775.47724	2126.05011	1780.44801	-0.2610345	-0.2131796
9	2276.83185	1840.75824	2285.63334	1846.39485	-0.4317931	-0.34813
10	2267.10282	1762.6684	2275.29891	1768.29925	-0.1881067	-0.2939118
11	2177.55834	1725.98867	2184.66647	1730.6991	-0.1921394	-0.465238
12	1850.31536	1588.44993	1851.20133	1590.27725	-0.1259279	-0.6443359
13	1917.15127	1641.99934	1914.74308	1644.72005	-0.633707	-1.120935
14	1859.89683	1600.76262	1858.51708	1602.63804	-0.4363566	-0.974786
15	1813.38288	1502.17278	1805.75572	1500.07021	-0.4708121	-0.975272
16	1906.37658	1561.1461	1899.09402	1560.09499	-0.667923	-1.1175947
17	2079.95224	1677.80016	2082.11684	1682.37759	-0.9137455	-1.0561082
18	2071.32285	1739.49555	2075.8038	1743.9871	-0.4338728	-0.329622
19	2156.25523	2072.83036	2164.39203	2080.82267	0.35989523	-0.5733126
20	1847.34192	1708.75422	1845.35874	1709.33385	0.47633992	-0.1021707
21	2039.83504	1867.88782	2044.04347	1872.5624	0.00487783	0.15222497
22	2043.8295	1896.86078	2048.79416	1902.14064	0.06346176	-0.1319073
23	2227.85462	1979.32718	2235.38353	1985.86633	-0.5223743	-0.2861181
24	1813.93778	1717.05963	1809.02179	1717.45781	-1.1093438	-0.8414575
25	1739.09652	1592.36213	1733.52794	1594.78627	-0.9211515	-0.450781
26	2073.65844	1754.88545	2077.57365	1759.22315	-1.3038889	-0.5393235
27	2251.53523	1871.19535	2258.22921	1875.28921	-1.2563877	-1.2409742
28	2069.80826	1871.94442	2073.60679	1874.67461	-0.0972716	-1.288269
29	2189.83481	1942.85346	2193.78714	1947.64562	0.32851794	-0.0187685
30	2366.78595	2116.50633	2376.4035	2124.73588	0.57495122	0.02078083

31	1755.2941	1777.66976	1740.45103	1766.14575	-0.2025294	-0.181576
32	1679.35469	1687.66355	1651.52162	1662.36243	0.33308304	-0.3359292
33	1505.80801	1543.01644	1420.92173	1462.13176	NaN	-0.2005457
34	1480.66811	1442.7152	1479.149	1444.91309	-1.3881961	-0.9367154
35	1401.4346	1349.13593	1386.85967	1353.06338	-1.1384066	-1.5013732
36	1320.04529	1245.76695	1278.38494	1263.63183	-0.9181734	-1.9936843
37	2154.81149	1968.69762	2492.15047	2311.63744	-6.9683824	-6.3838053
38	1675.22936	1572.25069	1675.49563	1571.26151	0.04952386	-0.0789993
39	1789.91421	1663.4353	1790.06699	1666.06691	0.27536057	0.25000024
40	1729.66302	1681.12105	1728.78764	1680.27375	0.02423281	-0.0192129
41	1713.81993	1821.06884	1715.19918	1824.66874	-0.667597	-0.3163224
42	1909.01118	1840.77502	1913.01863	1844.87595	0.07840601	-1.2536491
43	1786.38845	1860.13871	1789.58019	1864.51587	0.24780835	-0.5558238
44	2014.51052	1837.48541	2018.25431	1842.42956	-2.1006027	-0.7482597
45	2528.10532	1845.44501	2534.09781	1851.2698	-2.9070713	1.18097966
46	2342.94196	1712.39403	2336.54903	1714.76644	-2.9148614	0.80043383
47	1743.70988	1501.75264	1650.91982	1488.45819	-4.0758911	0.14663842
48	1765.90595	1502.41489	1701.97825	1492.72097	-4.0516313	0.24236422
49	1661.74818	1469.55077	1643.44684	1469.98122	-4.9173748	-0.4683626
50	1887.93429	1471.37492	1878.58016	1473.33062	-3.6872166	-0.4182596
51	1789.23367	1569.69993	1780.30665	1571.44115	-4.1819738	0.15187696
52	1594.89028	1883.05093	1596.38788	1882.23087	-0.2321343	-0.6709425
53	1504.54891	1823.66508	1502.4928	1822.42123	-1.263955	-1.2680533
54	1626.14144	1833.81129	1625.97032	1835.66447	-1.4186881	-1.0202182
55	2292.75208	1886.21157	2299.05636	1890.64086	1.21111471	-2.2792851
56	2039.84826	1805.91991	2044.97774	1810.47664	0.93226153	-1.2160116
57	1682.96258	1906.67055	1682.45966	1914.07423	-0.5019315	0.14827217
58	1419.91816	1941.5789	1418.41625	1948.20885	-0.9106644	-0.3421554
59	1500	1500	3755.54085	4225.24543	NaN	NaN
60	1911.34276	1578.6542	1910.02266	1575.76632	-0.6161271	-3.5951096
61	1854.38185	1438.51611	1847.79612	1429.55981	-2.0993701	-3.40367
62	1799.5697	1441.27769	1794.95999	1446.90807	0.21210568	-4.7277429
63	1735.34349	1476.74261	1722.34534	1481.46362	0.27995408	-7.5561414
64	1715.73486	1487.49734	1706.69305	1480.13535	-0.1539574	-9.2966781
65	1687.23755	1444.32226	1682.73322	1448.67339	-0.0489802	-8.8772925
66	1647.73737	1447.70579	1642.01522	1436.00959	-0.0180761	-7.4552701
67	1597.39306	1476.37059	1591.83812	1460.86491	0.10959965	-12.812075
68	1603.8692	1491.69947	1595.17197	1459.70016	-0.1485533	-18.059398
69	1483.77738	1469.85429	1480.38544	1456.48768	0.17155869	-20.057623
70	1486.38382	2322.12289	1402.73438	2094.58121	0.83889729	NaN

71	1264.81209	1283.40806	1309.89515	1337.50701	-2.5051459	-10.608545
72	1365.64494	1308.22248	1380.81732	1313.75001	-0.8577523	-2.6397086
73	1340.86058	1301.20957	1334.26926	1305.53747	-1.3941675	-5.1995567
74	1209.94004	1237.66162	1253.35695	1265.57662	-1.6285304	-8.6920349
75	1315.33517	1313.99858	1321.05007	1318.08488	-2.0104724	-3.9571454
76	1363.18745	1348.28684	1364.70437	1349.23937	-0.8796609	-1.5140174
77	1433.07657	1430.29355	1435.34893	1431.5711	-0.8327671	-0.920381
78	1596.67787	1567.98955	1599.70668	1571.77509	-0.8087162	-0.8594323
79	1866.71489	1841.7678	2032.12597	2056.84027	-1.5961035	-1.5851648
80	1500	1500	2786.37903	2407.3036	-5.8574887	-5.0444815
81	2170.36318	1920.70113	2177.51883	1926.89312	-1.2379766	-0.3535536
82	2164.20131	2026.90872	2171.00528	2033.28455	-2.2995914	-2.1002719
83	2357.14716	2407.84443	2366.20748	2419.77843	-2.4176723	-3.9272642
84	2176.62086	2107.53542	2176.52754	2108.54039	-0.0381977	-2.4461329
85	1932.57117	1855.36642	1910.06356	1845.36454	-0.8703744	-1.7095059
86	1771.22779	1630.88703	1710.63964	1606.75653	0.09637196	-0.6612554
87	1586.80128	1555.56612	1550.93954	1523.39233	-1.468837	-2.6756151
88	1436.81068	1404.20617	1437.72657	1410.22211	-2.117739	-3.3437322
89	1327.04853	1377.6384	1420.58075	1453.18332	-9.9544255	-11.956579
90	1378.90082	1226.50835	1335.39217	1220.18388	9.08080618	-2.1748499
91	1310.88113	1265.93635	1253.91855	1254.12368	-2.9968849	-0.4756312
92	1345.47015	1355.56132	1340.40527	1354.02713	-0.8620434	-0.0964605
93	1417.93976	1400.47779	1411.36248	1399.2163	-0.4191009	0.21117729
94	1462.17858	1466.59296	1460.84095	1466.02435	-0.3962039	0.33063795
95	1593.52254	1665.03267	1594.06997	1625.9398	-0.2898653	1.10809774
96	1696.52441	1686.27689	1695.7874	1683.14335	-1.0472281	0.79824646
97	1793.31036	1767.5915	1789.22171	1770.2943	-0.6769265	0.62846587
98	1682.28643	1655.96477	1667.23071	1648.28481	0.20699321	0.46618707
99	1624.733	1587.90927	1602.11459	1572.68053	0.80410769	0.79874653
100	1796.80889	1687.79385	1791.93712	1687.37608	-0.3198013	0.85863717
101	1867.4308	1745.32294	1867.57512	1747.88559	-0.6714858	1.43014986
102	2248.5311	2411.13031	2257.14663	2442.77346	-0.195767	-2.7185666
103	2121.52713	2140.99326	2126.823	2148.2265	0.59270867	-0.5356346
104	1841.10648	1838.43829	1829.5447	1836.30947	-0.100013	0.52039808
105	1641.91083	1676.86022	1604.6551	1639.37445	1.28244383	1.04672746
106	1688.80623	1677.92369	1686.39105	1679.2318	-0.231321	0.15721427
107	1543.02465	1556.45658	1532.41018	1549.22028	0.277556	0.04683019
108	1444.83281	1417.63919	1393.22045	1406.39871	1.26175139	0.35939667
109	1408.94472	1401.86257	1376.49918	1383.26202	0.48553383	-0.1718149
110	1320.36079	1311.57516	1207.05813	1261.94527	NaN	0.03235093

111	1302.45254	1320.53869	1292.70124	1307.5817	-0.3156253	-2.2631223
112	1355.64439	1357.75577	1335.1884	1345.42619	0.14362789	-0.9522165
113	1453.36866	1435.78334	1446.08255	1434.75058	-0.084851	-0.2114678
114	1580.99389	1555.52508	1580.89459	1557.22086	-0.5002184	0.13413272
115	1748.49845	1725.69424	1752.60071	1796.84456	-0.4536983	1.49683868
116	1729.6239	1706.76663	1730.7548	1710.13929	-0.3165346	0.40007399
117	1906.33855	1834.46381	1908.97739	1839.83662	-0.8087662	0.7642995
118	1818.99032	1809.53997	1806.96162	1804.78661	0.21653081	0.55744727
119	1991.79032	1959.28542	1989.65043	1963.93771	-0.2812387	1.02855403
120	2089.84023	1979.78088	2089.97301	1979.53553	1.07099853	0.1881746
121	2070.87269	2099.31723	2074.46893	2106.85089	0.49174549	1.21870346
122	2054.5592	2028.34944	2058.0286	2033.52965	1.21532069	0.40144311
123	2169.37701	2378.52729	2175.92659	2390.47203	1.56444798	0.97472197
124	2028.55464	2047.91721	2029.46035	2050.86259	2.0498306	-1.3403471
125	2713.0417	2485.43609	2729.69407	3063.27059	-0.1290138	-14.506284
126	2860.66031	2376.67384	2873.92564	2384.95242	1.8873438	-0.1273194
127	1794.27064	1883.00983	1647.82486	1802.41075	3.0892213	1.35793954
128	1870.51764	1951.49962	1860.00451	1951.81389	0.27674472	0.31835967
129	1885.79171	1890.53883	1867.78882	1885.30286	0.07599653	0.37635737
130	1850.43023	1937.83567	1841.56316	1936.45317	1.23325883	0.78341363
131	1857.82383	1997.04958	1857.6153	1995.42841	3.03488529	-0.405779
132	1984.72171	1963.18619	1987.61834	1969.32404	1.15317048	1.29905746
133	1950.42404	1905.79524	1946.81533	1909.25118	-0.2742239	0.78106391
134	2406.40282	2565.13915	2417.07703	2581.95379	-1.2279981	-1.0713407
135	1764.15891	2004.23113	1757.02783	2002.527	2.07836276	0.50980372
136	1500	1500	5114.35901	4966.27224	9.88019132	-27.978126
137	2679.36481	2548.80652	2683.16057	2492.49599	1.85746607	3.13469561
138	2604.82064	2187.41585	2599.45234	2099.8101	1.25461426	5.29070892
139	2103.49422	300	2055.70849	1589.05352	1.02135637	NaN
140	2289.09528	2279.07058	2294.52811	2270.64662	0.35424187	1.84493863
141	2179.64341	2159.92138	2179.58948	2135.53418	0.56574536	0.28263717
142	2053.3766	2088.0659	2041.39912	1973.49835	0.28843655	-0.6118735
143	1870.92466	1998.6833	1871.77627	1942.00756	0.06054998	-2.2135439
144	1940.88738	1968.06905	1947.68226	1964.64207	0.32485825	-1.9515397
145	1789.37222	1971.30045	1789.7341	1951.08745	0.10661081	-7.4325094
146	1811.36542	1927.62433	1810.9596	1874.6129	0.04847311	-5.1777754
147	1686.75605	1896.66924	1689.57638	1874.32085	1.25303181	-9.0672426
148	1535.55766	2308.14628	1527.88104	2089.87245	-0.4666965	-46.374816
149	1432.82602	3459.92493	1421.17676	2750.13829	-1.2787126	NaN
150	1487.73196	6064.16564	1513.76372	3429.62248	NaN	NaN

151	300	5515.96252	1646.06488	1974.2945	NaN	NaN
152	1412.22816	1505.93987	1406.8145	1492.02544	-0.0017859	-4.3691312
153	1411.70768	1386.90595	1408.97975	1382.84075	-0.1699971	-1.7608101
154	1432.15916	1441.83648	1431.13708	1440.26853	-0.2792351	-2.0502219
155	1494.63062	1509.54235	1495.05588	1509.28835	-0.5478695	-1.8144045
156	1544.24146	1654.53365	1546.22484	1658.18063	-1.118553	-1.826529
157	1543.12344	1662.05982	1543.42197	1664.32453	-1.6540727	-1.7001704
158	2140.19077	2215.59165	2088.41314	2259.16789	-4.5072916	-3.860673
159	1534.21475	1803.85737	1530.72872	1805.83576	-3.75868	-2.1590952
160	1641.4894	1884.0352	1641.48673	1885.96977	-3.1326443	-2.3685214
161	1729.92173	1993.33362	1730.012	1998.15525	-1.4606547	-0.4972965
162	1783.76243	2237.2203	1787.15397	2247.03411	-1.9115354	-0.0578622
163	1877.30858	2436.25955	1881.2865	2448.50809	-1.9690845	-1.1071829
164	1768.81067	2090.24375	1767.27618	2097.20838	-1.4127908	0.25735784
165	1893.24795	2172.10591	1894.13701	2179.18653	0.07286797	0.53514654
166	1681.79908	2057.30945	1674.40255	2057.3005	-0.8936248	0.67982041
167	1860.23346	2401.83131	1863.28398	2413.96433	-1.0215342	0.43244056
168	1774.99682	2240.36327	1772.45305	2246.52593	-0.1599738	0.56028353
169	1824.87754	2081.60656	1819.95469	2086.19453	0.19634279	-0.0160467
170	1867.63436	2389.13639	1868.99356	2400.9074	-0.4830928	1.13930035
171	1892.56445	2310.29282	1874.17742	2309.29951	0.65273826	0.14356764
172	1737.62047	2199.19962	1716.43505	2198.14669	0.81817227	1.00196159
173	1656.05516	2038.66952	1629.27279	2027.50076	1.43529029	0.54905979
174	2004.16681	2322.57232	1994.44479	2327.03066	0.9721704	0.40448227
175	1760.00935	2149.262	1731.9796	2147.38127	2.22463179	1.20046838
176	1585.88697	1946.03949	1446.667	1906.30551	3.76138013	1.39732707
177	1857.81015	1614.48277	1825.93314	1599.02939	-1.8315233	-0.2503827
178	1706.6741	1505.84391	1648.87792	1497.48395	-1.1633882	-0.2022689
179	1889.39703	1507.75929	1892.69928	1508.10297	-2.3519938	-0.9010796
180	1687.969	1538.6353	1682.58992	1533.48217	-1.557407	-1.0223337
181	1733.44248	1400.59719	1732.17086	1387.3407	-1.0644503	-2.6797579
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183	1804.46133	2205.08766	1652.38345	2025.37748	-18.708699	-8.9837628
184	1528.91505	1894.29516	1535.16895	1886.8236	-12.732534	8.05474455
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186	1534.65487	1539.80426	1551.93024	1541.51211	-10.209612	NaN
187	1461.39836	1324.6166	1468.89735	1322.36382	-1.3093403	-17.880576
188	1492.81329	1448.86063	1499.27468	1444.73045	-3.5313282	-34.879775
189	1479.96156	1330.55679	1484.36032	1330.47679	-0.1180807	-10.500518
190	1449.26607	1301.81243	1452.99202	1303.61347	0.65343328	-6.247388

191	1527.71246	1373.66727	1530.93656	1375.96252	1.31257328	-1.1945772
192	1417.91133	1380.44666	1416.24768	1379.36543	0.83839628	-1.0454347
193	1470.32011	1465.41501	1470.96302	1466.93572	0.34175717	-0.1580955
194	1635.16161	1704.86912	1637.56463	1708.72847	0.29430756	-0.2663137
195	1515.90334	1596.13211	1498.12289	1567.36914	1.05583527	0.07575513
196	1600.43275	1572.25828	1586.33818	1545.51018	1.03795223	-0.1288079
197	1506.26061	1452.00548	1489.70273	1414.0308	1.75780956	-0.5735731
198	1541.09063	1561.07686	1538.32009	1555.09863	0.95119439	-1.0311744
199	1371.24893	1452.26983	1351.10181	1432.63801	1.94190416	-0.1187131
200	1480.58267	1621.80222	1478.59129	1616.77569	1.62437468	-0.7651236
201	1310.07531	1522.67006	1295.66059	1515.13006	0.30388009	-0.5698128
202	1573.41172	1627.49831	1563.5921	1621.88487	1.60179217	-0.0935407
203	1385.8248	1561.4914	1367.2725	1551.02905	1.29506343	-0.098963
204	1547.40764	1779.79493	1536.0843	1780.1528	-0.4434809	-0.2624388
205	1763.77622	1817.45385	1764.92796	1819.41521	0.72862896	-0.689222
206	1663.42369	1687.25488	1661.95429	1683.78741	-0.2873541	-0.8005105
207	1627.77431	1647.60019	1624.30527	1637.11623	0.20710835	-1.1921032
208	1825.26379	1749.17727	1825.45882	1749.05986	-0.335216	-1.6025572
209	1775.66752	1657.47847	1772.39415	1659.56498	-0.4492977	-1.1605806
210	1462.52773	1429.52011	1431.90556	1406.01294	-0.0747791	-0.5890245
211	1574.87196	1564.96835	1575.09029	1566.28171	-0.5511399	-1.1827833
212	1549.12275	1697.56018	1549.89867	1700.68994	-0.093151	-0.2471973
213	1535.34694	1746.85796	1536.28202	1750.68326	0.02371009	-0.2565459
214	1481.30088	1640.85319	1481.81465	1644.44608	0.28144468	-0.4402899
215	1478.15285	1668.70736	1476.45014	1670.20102	0.10000505	-0.4371858
216	1396.96735	1539.90548	1391.06527	1536.06801	0.32276752	-0.633951
217	1396.81583	1511.15742	1388.85381	1506.83061	0.69128251	-0.4221392
218	1471.13193	1523.58496	1466.47592	1522.34324	0.6186021	-0.4757661
219	1444.11091	1487.70499	1440.38663	1485.62036	0.8247052	-0.6783561
220	1335.26169	1379.03836	1328.75344	1379.94138	0.70928977	-0.5724361
221	1347.88244	1320.64594	1336.109	1315.18942	1.29724159	-0.0603534
222	1317.96107	1307.2517	1312.62529	1306.91949	0.28809004	-0.4752788
223	1313.85169	1328.44679	1313.14052	1319.46073	-0.0559479	-0.685302
224	1451.99455	1462.68578	1453.06431	1465.34969	0.65178603	-0.4595641
225	1643.35945	1657.29903	1646.7958	1661.08255	0.69434952	-0.546362
226	1714.32742	1744.43175	1717.24695	1748.79119	0.02524973	-0.7077422
227	1660.80678	1746.11735	1654.98719	1740.09915	0.09532784	-0.4128185
228	1600.20017	1653.24734	1575.15052	1639.90118	0.2661575	-0.4372312
229	1548.10269	1575.99968	1525.96822	1551.67786	0.72821801	0.08856106
230	1548.85963	1614.61481	1515.76929	1589.57165	1.15017241	0.6364356

231	1607.54952	1737.22952	1608.6292	1740.99472	-0.0461577	-0.2160097
232	1457.97458	1604.61762	1454.93197	1604.97621	0.05993687	-0.3304896
233	1436.79539	1557.71776	1433.18447	1559.67848	0.27527994	-0.3237815
234	1538.39194	1695.59447	1538.4259	1697.95721	0.46954489	-0.2009893
235	1422.35664	1513.40479	1413.88119	1506.78311	0.45433766	-0.1862201
236	1328.88315	1414.10015	1312.24434	1407.84036	0.33695871	-0.1048264
237	1245.96899	1322.94752	1241.38674	1314.98494	-1.4517572	-1.2302859
238	1322.25595	1293.24888	1289.13374	1254.56059	-5.2034623	-4.7081711
239	1474.9312	1370.14851	1431.65569	1356.5279	-9.2690341	-21.334836
240	1398.80923	1319.72719	1381.96027	1310.41615	-5.6766152	-9.5460518
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243	1320.73617	1323.74636	1318.55329	1321.41583	-1.4890932	-2.6971214
244	1294.3491	1338.34534	1301.81736	1339.72426	-2.0072507	-0.7295426
245	1224.67928	1376.41842	1214.48429	1375.39408	-5.3675707	-2.0592612
246	1198.55129	1308.47172	1210.58266	1310.69871	-8.8786146	-5.8695552
247	1204.50918	1362.77033	1198.27389	1362.65954	-4.7054808	-2.4029014
248	1374.40023	1423.30395	1370.07463	1423.12822	-1.8073013	-0.6402441
249	1352.05662	1562.3944	1351.59449	1565.37423	-0.8469431	0.73183052
250	1459.04612	1866.02651	1312.47037	1832.84547	-1.8018191	-2.165804
251	1559.82049	1856.27852	1296.54164	1739.58208	NaN	-13.932721
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253	1559.83635	1305.51202	1566.4963	1306.16394	-0.7907414	-0.9139841
254	1685.80779	1390.80712	1689.6514	1391.25001	-0.4168612	-1.0200484
255	1767.45352	1466.28972	1771.94351	1468.57148	-0.0117831	-1.3757764
256	1841.79211	1478.01729	1845.09238	1479.03437	0.17056616	-1.4750086
257	1744.4704	1658.09926	1748.09974	1732.80858	0.26200573	1.19864595
258	1738.1883	1609.39244	1735.56893	1611.7466	0.19503865	-0.0213389
259	1870.83293	1755.28778	1870.27356	1757.229	0.31198306	-0.0469831
260	1844.57374	1723.67252	1841.09209	1726.49542	0.31972103	0.00319046
261	1934.66793	1802.79976	1937.37804	1807.46615	0.07496189	-0.0232094
262	1924.24088	1800.68087	1922.84879	1804.04876	0.11102684	0.56249568
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264	6698.65095	4723.74434	4794.99999	2825.13751	NaN	NaN
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267	1478.47996	1675.71831	1481.0817	1705.8969	-1.4901149	0.08667253
268	1534.76165	1712.28526	1534.83653	1717.05277	-1.2856282	-0.5275197
269	1551.95078	1711.05801	1534.65216	1710.25634	-0.7605172	-0.2694619
270	1649.49744	1781.17709	1641.67828	1783.11957	-0.8236228	-0.5761932

271	1772.98789	1877.86486	1772.52842	1881.96618	-0.7013651	-0.2042671
272	1924.67329	2091.72217	1929.94033	2099.82073	-0.4083423	-0.1751969
273	1938.2569	2074.554	1941.36626	2081.15686	0.32368769	-0.1495338
274	2099.55874	2177.53248	2105.47785	2186.01478	0.8975799	-0.312821
275	1902.6184	2012.59494	1903.77341	2016.88309	0.71232605	-0.4414605
276	1859.06651	1962.96896	1857.60153	1965.0473	0.74607719	-0.4347675
277	1730.98354	1795.63206	1724.16975	1788.60718	0.76193843	-0.1156592
278	1709.90969	1820.46908	1701.45615	1819.69849	0.5148825	-0.4633683
279	1599.01445	1708.65034	1589.90872	1705.41814	0.44490271	-0.2141861
280	1455.76796	1562.60755	1455.74737	1567.21597	0.21783385	-0.4626092
281	1374.14894	1469.51388	1357.28571	1466.8427	-0.0559686	-0.9069789
282	1305.81719	1388.42448	1269.26982	1393.87921	-0.1618068	-2.6214994
283	1371.91023	1465.71035	1351.31636	1461.66322	-0.073626	-0.7363858
284	1446.69176	1557.84699	1439.38144	1561.07039	0.11768772	-0.4618677
285	1514.78962	1615.34908	1511.27334	1617.49706	0.16114031	-0.3611945
286	1527.5129	1644.31268	1526.93233	1646.34296	0.20768491	-0.41949
287	1598.69616	1728.84394	1600.7225	1733.92585	0.11574678	-0.3373854
288	1590.99477	1739.22246	1589.8985	1744.45881	0.2067151	-0.3581577
289	1607.80955	1765.82252	1608.49264	1769.57128	0.22477293	-0.3974647
290	1699.7768	1841.68497	1701.96453	1846.72656	0.12272711	-0.3324445
291	1746.10133	1891.22445	1745.81466	1894.70581	0.16191274	-0.22697
292	1803.49499	1992.78564	1802.71435	1998.41505	0.21540203	-0.4044655
293	1917.75652	2115.16722	1919.59315	2123.70102	0.04917886	-0.4101463
294	1818.38436	1962.04967	1819.08123	1967.11571	-0.3323126	-0.5044171
295	1698.04406	1813.97151	1697.02754	1818.24462	-0.3594856	-0.4633972
296	1571.10787	1676.19285	1558.98589	1682.45476	-0.2234405	-0.529669
297	1475.68518	1581.7666	1471.12656	1583.33824	-0.3792272	-0.702581
298	1387.8686	1470.96676	1369.89852	1481.45888	-0.6780701	-1.6231508
299	1338.9661	1456.69533	1286.07225	1453.72207	-1.745065	-5.1540414
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303	1512.25054	1681.17974	1511.63695	1716.16793	-0.3584779	0.7772574
304	1552.92703	1684.52197	1544.01853	1687.67675	0.37083143	1.21636215
305	1558.11725	1659.48712	1395.14485	1645.7634	NaN	1.81151889
306	1534.97004	1670.49229	1413.94248	1660.74541	3.92530277	1.56627143
307	1580.88545	1655.60953	1466.49023	1641.68622	4.12510074	1.29470231
308	1532.00673	1622.61016	1505.04411	1622.2111	0.81049374	0.59231586
309	1639.08443	1737.21874	1632.28596	1740.20284	0.42025474	0.37646957
310	1628.51053	1734.37545	1621.14707	1737.19275	0.21481696	1.05856127

311	1771.15653	1856.49726	1771.21241	1906.34693	0.04947705	1.14226618
312	1748.78947	1850.01796	1729.8773	1849.81574	0.60926525	0.7494553
313	1723.84878	1757.33799	1700.75315	1754.93669	0.79266955	0.97046122
314	1659.20365	1753.32814	1637.6762	1751.90412	0.91083288	0.8276055
315	1600.59388	1700.82533	1571.49778	1697.18088	0.87750656	0.76797432
316	1674.50388	1753.63605	1649.21236	1751.99492	0.86160081	0.85788325
317	1608.91005	1713.34488	1584.0623	1706.63679	1.12229357	0.86090264
318	1620.06158	1779.09873	1604.2135	1776.65213	0.94224438	1.08244624
319	1658.80525	1760.80534	1648.81154	1758.01786	1.16465412	0.68909404
320	1569.37978	1672.31103	1543.9754	1646.40213	1.30879788	0.90777627
321	1414.98281	1464.62425	1328.56405	1354.53275	NaN	NaN
322	1456.37921	1499.40854	1451.07563	1494.67897	0.80009933	0.09894267
323	1484.79125	1534.00338	1482.90383	1534.72266	0.90748383	0.06448353
324	1561.99217	1614.99753	1560.27308	1613.70487	0.64371539	-0.344451
325	1537.09518	1546.65629	1534.83093	1546.09023	0.84622216	0.00415745
326	1554.17584	1543.77428	1553.14189	1541.54198	0.66616831	-0.1735658
327	1614.64989	1526.15808	1614.06792	1526.17088	0.11562394	-0.092259
328	1684.32304	1505.30753	1685.25582	1506.51659	0.26925431	0.24406445
329	1656.10275	1589.63723	1656.99224	1591.79467	0.76908714	0.64048662
330	1575.89932	1548.59903	1576.0212	1548.49147	0.56162719	-0.2082724
331	1742.72116	1791.66992	1745.99418	1793.66282	0.56489693	0.47731883
332	1713.02123	1750.16262	1692.24141	1741.88965	0.88097296	0.80774553
333	2028.71571	2007.55295	2030.49728	2012.66116	-0.0234383	0.13379981
334	1801.66116	1687.69316	1769.12966	1684.30454	1.17841615	1.31760885
335	1970.9021	1853.02497	1973.08274	1857.34381	-0.1291713	0.44199438
336	1869.9206	1664.46366	1869.49662	1666.66997	0.10724934	0.74120742
337	1778.11606	1564.88347	1771.23562	1562.54206	0.06887606	0.81619875
338	2313.9781	1929.0464	2321.90598	1930.08819	-0.1807899	-0.865893
339	1879.30765	1838.2749	1851.52228	1831.15998	-0.2276624	-0.4472146
340	1645.5643	1475.92172	1570.76141	1415.50621	2.29607857	1.16710325
341	1742.88897	1535.29651	1738.97596	1534.06917	-0.3978128	-0.4444436
342	1676.4339	1404.55555	1670.19105	1402.68099	0.0299831	0.18814017
343	1636.43905	1332.0683	1627.93742	1328.96969	-0.0283296	-0.1280874
344	1508.24442	1292.43925	1497.04039	1285.07858	0.11609605	-1.4343129
345	1594.35222	1429.57315	1583.21352	1424.3748	0.05101654	-1.7692323
346	1649.78128	1537.60063	1644.57256	1534.13332	-0.2764063	-1.9286117
347	2169.42051	1726.112	2176.43204	1730.25577	-0.1526046	-2.5859851
348	1775.9558	1462.35772	1755.33476	1457.01333	-0.0878467	-0.4205444
349	1947.43155	1917.04576	1949.54768	1962.90912	-1.2198503	1.78887976
350	1593.8205	1538.64128	1475.71134	1500.83716	3.20119285	1.34912603

351	1504.00263	1533.25024	1411.22044	1495.50264	2.63089858	1.49315272
352	1523.76422	1655.11768	1484.22203	1644.70139	0.73103753	0.6257124
353	1548.79719	1818.26581	1507.52968	1813.30121	0.25575479	0.76940805
354	1671.08284	1572.43582	1649.68242	1563.77622	0.14987221	0.32558084
355	1519.73717	1550.78226	1459.40217	1513.99753	1.41242669	1.11924734
356	1461.50544	1525.02817	1269.13046	1473.64128	NaN	1.81713822
357	1608.69978	1563.03825	1604.89455	1561.5567	0.00149998	-0.1380238
358	1758.58547	1643.43867	1752.58848	1645.00962	-0.5415707	0.2864182
359	1674.88227	1860.86666	1668.83927	1864.65518	-0.3967596	0.13876528
360	1500	1500	3755.54085	4225.24543	NaN	NaN
361	1430.13207	1624.2291	1393.91511	1598.23417	1.59475035	-0.9187696
362	300	300	3540.50963	7909.90798	NaN	NaN
363	300	300	3085.02309	7606.91223	NaN	NaN
364	300	300	4606.22056	6125.7376	NaN	NaN
365	300	300	5432.46095	7884.98472	NaN	NaN
366	3700.87244	2279.45306	3487.64868	2277.8525	-12.902187	NaN
367	2704.81725	1899.92938	2668.75946	1908.20506	-46.476328	NaN
368	1522.13267	1468.79674	1547.35593	1471.28249	-11.365857	-4.7830365
369	1596.21053	1594.97852	1583.88002	1598.20703	-7.2917382	-1.2301097
370	1658.32379	1682.49546	1659.39906	1742.09835	-4.9369868	0.94093797
371	1722.43174	1639.16771	1703.30756	1642.27436	-4.2461306	0.11940399
372	1758.13068	1678.45293	1742.2282	1681.19433	-3.5083758	-0.126587
373	1740.3384	1798.68166	1732.19929	1809.08166	-2.4244615	1.13984939
374	1841.43547	1816.1675	1778.83281	1817.4369	-1.3834078	0.56306033
375	1636.64965	1656.71101	1402.82278	1633.839	NaN	-2.0066324
376	1702.38089	1895.27252	1565.38997	1885.72495	1.05449999	-0.1981072
377	1713.66048	1773.98027	1549.77124	1763.2581	0.51283408	1.26794012
378	1491.19775	1560.57368	1356.89044	1542.95683	1.6566646	-2.3133789
379	1553.74872	1601.63257	1470.07771	1594.38423	0.56663182	-0.8875611
380	1749.57317	2187.59698	1735.21301	2195.51924	-0.6926383	-0.2772833
381	1670.64689	1782.19232	1653.31311	1784.77024	-1.1892749	-0.5793275
382	1597.60042	1659.7875	1565.86657	1658.34652	-0.7383184	-1.721694
383	1544.00243	1653.04648	1457.24231	1636.9218	0.73625727	-6.8242329
384	1799.69249	1741.88795	1761.74203	1744.53316	-2.9540678	-1.5068364
385	1633.90622	1713.39753	1620.17285	1716.53071	0.23458864	-1.2685766
386	1760.27089	1763.48567	1754.94854	1766.89483	0.23953272	-0.564151
387	1612.83293	1751.45362	1606.76967	1754.94345	-0.619965	-0.8491378
388	1623.97904	1770.59898	1622.85618	1775.2007	-0.9764039	-0.4980537
389	1587.7206	1803.7809	1584.34988	1807.66038	-0.7326717	-0.6792833
390	1527.32907	1717.69177	1512.91758	1718.69746	-0.761033	-1.1070194

391	1423.26208	1647.84087	1396.51548	1646.14259	-0.2525025	-2.3165498
392	1484.92961	1595.66899	1439.19888	1593.24798	0.16053002	-2.8003799
393	1362.98218	1603.02607	1346.02973	1600.78976	-0.8747146	-2.9983531
394	1360.37172	1602.95671	1342.4164	1598.82994	-0.9531633	-4.5959528
395	1325.22749	1595.31889	1291.99173	1583.0343	-2.0081336	-9.5385895
396	1405.42624	1621.76191	1401.98734	1625.51401	-1.809376	-2.8505687
397	1381.10657	1650.68622	1367.03135	1651.89109	-8.245891	-29.114114
398	1253.42397	1524.7582	1301.98898	1528.52812	-6.1953054	-8.1241501
399	1330.81642	1715.48474	1388.42636	1732.56074	-23.11652	-37.63145
400	1426.7174	2145.45365	1504.33996	2166.61478	-29.437861	NaN

	Files	**~ pressure**
E1 - MgO foil	1 thru 36	39
E2 - MgO foil	37 thru 70	27
	71 thru 150	43.5
	151 thru 181	60
cell 6 - Pt foil	182 thru 251	14
cell 1 - mix	252 thru 300	22
E1 - MgO foil	301 thru 361	52.5
	362 thru 400	19

GSECARS 2/2020

File	log US T	log DS T	my US fit	my DS fit	dT/dλ US	dT/dλ DS
1	1321	1242	1403.27179	1331.40692	0.17926185	-1.5513695
2	1312	1222	1474.96931	1465.7472	-0.3396814	-2.0785994
3	1499	1462	1458.61322	1603.0372	0.22464342	-1.4293054
4	1966	1704	1457.28663	1593.20929	-4.114325	-1.1146321
5	1766	1703	1410.22816	1606.73171	0.44992011	-1.368734
6	1682	1820	1667.98925	1814.77787	0.30662635	-0.5518049
7	1720	1851	1708.69636	1847.45455	-0.0855311	-0.5333703
8	1733	1834	1720.45761	1831.5103	0.26377315	-0.3028931
9	1323	1358	1311.24209	1351.94338	-0.0394556	-0.5508449
10	1159	1159	1147.26742	1133.73688	-1.3922958	NaN
11	1270	1174	1258.48261	1158.25499	-0.5095014	-3.6893841
12	1369	1274	1358.83264	1267.33729	-0.0622722	-2.1178265
13	1470	1302	1459.52952	1294.12277	0.05767682	-2.0939546
14	1503	1320	1492.7624	1312.07509	0.19169732	-1.7411558
15	1597	1452	1587.51781	1445.93929	0.42853136	-1.0852023
16	1617	1525	1604.27237	1520.04077	0.29957194	-0.9867278

17	1658	1581	1643.72734	1577.45137	0.36736818	-0.7671526
18	1688	1632	1674.08406	1626.46762	0.45758947	-1.0012011
19	1617	1522	1603.51301	1516.80167	0.32528148	-1.0312701
20	1432	1344	1417.51921	1335.68678	0.17796132	-1.4265475
21	1532	1435	1516.97672	1426.85275	0.33547021	-0.875783
22	1566	1514	1551.67754	1507.00254	0.1664151	-0.7877549
23	1597	1611	1582.89631	1603.73097	0.3308133	-0.5528714
24	1688	1706	1674.37681	1697.78434	0.38112446	-0.8943373
25	1777	1810	1763.12327	1802.38277	0.5543309	-0.7242717
26	1701	1733	1689.27024	1721.05266	0.38424679	0.01834631
27	1670	1689	1656.86522	1680.90313	0.28731975	-0.4071221
28	1452	1465	1437.59878	1453.15914	0.15872814	-0.5251407
29	1438	1447	1424.29258	1436.54167	0.15239895	-0.32771
30	1555	1566	1541.33099	1556.56329	0.16116322	-0.4299639
31	1759	1770	1746.51058	1763.9348	0.47612326	-0.6434336
32	1761	1799	1748.14855	1796.60624	0.35160721	-0.4063338
33	1791	1861	1777.88705	1858.28907	0.39751564	-0.4548456
34	1791	1915	1779.0384	1916.0271	0.40483567	-0.3629657
35	1815	1928	1802.51382	1930.76645	0.52718183	-0.2479023
36	1815	1921	1802.77882	1920.53968	0.52130729	-0.2844568
37	1722	1808	1709.86679	1805.81676	0.36791367	-0.4935182
38	1762	1836	1749.87706	1834.45049	0.27705599	-0.4904294
39	1773	1790	1761.16366	1785.72414	0.37189481	-0.6297934
40	1849	1922	1837.79574	1924.27593	0.44274158	-0.6323005
41	1813	1918	1801.28701	1920.08116	0.52657679	-0.3821389
42	1886	2020	1874.25247	2024.4843	0.59904828	-0.2415619
43	1846	1934	1833.88383	1940.52344	0.48890906	-0.2690702
44	1876	1990	1865.52763	1995.58023	0.65466533	-0.1739783
45	1902	2027	1891.4841	2031.56001	0.55891592	-0.0604573
46	1728	1854	1717.62877	1867.35554	0.54701703	0.32600312
47	1605	1717	1593.84557	1721.10042	0.34048334	0.17413593
48	1567	1652	1554.65241	1656.09519	0.3394803	0.15377214
49	1610	1665	1598.14722	1666.26126	0.36585653	0.07023968
50	1545	1611	1533.22638	1610.39744	0.23687434	0.07219827
51	1472	1523	1460.87767	1522.97068	0.29590697	0.05694606
52	1357	1397	1343.41193	1398.15629	0.17204947	0.07641889
53	1284	1330	1269.7938	1323.48271	-0.1529743	-0.0358652
54	1290	1362	1278.71013	1357.82266	-0.0674083	-0.2724662
55	1219	1262	1212.1301	1261.8496	-0.6652649	-0.1889383
56	1148	1192	1138.43193	1185.6669	-1.5507421	-1.6604212

57	1131	1149	1119.8862	1124.86961	-4.9857756	-5.30623
58	2043	2226	2035.26924	2229.3144	-0.1822499	-0.925926
59	1242	1204	1229.20322	1198.88289	-0.2988467	-3.6029326
60	1328	1266	1318.45126	1262.45827	-0.2281618	-1.7795191
61	1514	1351	1500.82666	1342.95658	-0.3186955	-1.058334
62	1584	1391	1568.17251	1383.01931	0.2861701	-1.2247887
63	1615	1440	1599.52936	1433.11188	0.41923829	-1.3090631
64	1628	1478	1614.5291	1469.95013	0.51524348	-1.1059143
65	1622	1483	1609.68075	1475.00328	0.30519876	-1.017472
66	1703	1551	1691.33001	1542.19862	0.43244026	-1.2557302
67	1703	1556	1689.87705	1548.97684	0.49351489	-1.2793085
68	1667	1528	1654.16005	1522.05318	0.38866223	-1.178313
69	1485	1343	1472.20699	1335.49242	0.25827538	-1.1782968
70	1383	1225	1368.62764	1213.94255	0.0968454	-2.146919
71	1390	1246	1375.90855	1240.29679	0.10421422	-1.7209894
72	1486	1337	1472.871	1329.69016	0.29865989	-1.4590358
73	1648	1775	1634.61723	1775.88452	0.34344129	-1.2725687
74	1750	1919	1737.45711	1920.17347	0.27647816	-0.4950268
75	1565	1645	1551.99464	1641.17966	0.37752679	-0.1861149
76	1551	1655	1537.66181	1649.72417	0.35535549	-0.1728654
77	1556	1635	1542.95072	1629.72644	0.31086752	-0.332491
78	1657	1775	1643.00125	1774.10642	0.44536748	-0.1467985
79	1790	1909	1777.74544	1909.0231	0.40182535	-0.3042193
80	1733	1831	1721.10375	1832.63815	0.46784488	-0.2831072
81	1745	1835	1732.77683	1835.8701	0.50634286	-0.2937714
82	1745	1822	1733.028	1824.52812	0.46420149	-0.0752759
83	1768	1886	1755.13951	1887.49332	0.55975888	-0.1764812
84	1792	1890	1779.20204	1893.44962	0.58324171	0.07685229
85	1800	1899	1787.98609	1900.17726	0.50644705	-0.0246861
86	1628	1703	1615.51766	1701.634	0.38222077	0.09894124
87	1738	1848	1725.59951	1848.68317	0.50881695	0.06416478
88	1755	1859	1743.11508	1860.66847	0.60607832	0.06374203
89	1762	1888	1749.79682	1889.69335	0.55125342	0.01652632
90	1817	1923	1804.44841	1927.64665	0.62894038	0.07787851
91	1780	1860	1768.62911	1866.65078	0.54913715	0.07984745
92	1793	1883	1781.42578	1886.74476	0.4794355	0.01781921
93	1683	1771	1671.93393	1776.9513	0.49419083	0.09354436
94	1660	1763	1648.13772	1761.891	0.46418935	-0.0305629
95	1663	1734	1652.35172	1735.43729	0.5015261	0.18537841
96	1609	1674	1596.38301	1670.31194	0.44977652	-0.0047801

97	1621	1721	1610.43409	1718.79479	0.58704699	-0.0247691
98	1641	1735	1629.52931	1735.89638	0.42634399	0.0638328
99	1544	1610	1532.46003	1605.18386	0.47203194	-0.0693366
100	1481	1559	1467.74105	1552.63755	0.36356543	-0.0911304
101	1412	1482	1399.7942	1474.50707	0.28576049	-0.2486565
102	1462	1553	1448.71101	1544.79501	0.30275541	-0.2365821
103	1415	1487	1401.95873	1477.46235	0.05224024	-0.427262
104	1235	1236	1218.80756	1222.99804	-0.9392069	-1.8919122
105	1640	1743	1625.88713	1731.84379	0.22751192	-1.0197121
106	1709	1846	1696.13767	1835.66805	0.1908958	-0.1849393
107	1693	1823	1681.68885	1816.29673	0.38795224	0.10695579
108	517	1682	2766.12103	2252.94079	NaN	NaN
109	4005	4356	4196.24301	4396.06266	NaN	NaN
110	1202	1371	1200.23319	1385.46237	-11.142155	NaN
111	1236	1303	1219.99073	1307.35871	-2.8458751	-8.0801341
112	1347	1295	1332.4078	1286.91142	-0.2977296	-3.0816031
113	1544	1360	1530.9978	1349.82469	0.04596319	-0.8556013
114	1689	1531	1676.81769	1522.60553	0.31405391	-0.2338061
115	1732	1634	1719.90126	1626.82523	0.33123176	-0.3691639
116	1779	1684	1767.77437	1677.62723	0.32653994	-0.2859192
117	1882	1810	1870.0097	1804.3477	0.2747517	-0.2208853
118	1965	1953	1954.3556	1953.2385	0.47225586	-0.237873
119	1966	2009	1954.8715	2010.23092	-0.179343	-0.640943
120	2122	2138	2117.60094	2140.12011	-2.8876096	-0.1999277
121	2084	2090	2073.6094	2089.31623	-0.0615644	-0.5213754
122	2046	2159	2035.35562	2162.98588	0.10797713	-0.4420141
123	2139	2232	2129.81263	2236.85391	0.03311833	-0.7862056
124	2077	2189	2067.45374	2194.36729	0.37199499	-0.3596794
125	1954	2027	1944.73453	2025.23755	0.2102585	-0.368439
126	1857	1940	1845.69972	1940.58316	0.30417364	-0.2742952
127	1777	1820	1766.71825	1816.57807	0.31961018	-0.1038388
128	1701	1730	1690.02128	1726.02892	0.27278571	-0.2412787
129	1625	1649	1613.5929	1644.42467	0.15114279	-0.28158
130	1627	1649	1615.28988	1644.97748	0.28249139	-0.1117408
131	1559	1564	1546.80089	1558.70792	0.16243588	-0.2252844
132	1492	1502	1478.65898	1495.23625	0.28897887	-0.2823255
133	1487	1493	1474.29608	1486.63348	0.19047031	-0.3697034
134	1422	1420	1407.97889	1412.14532	0.06918218	-0.5802635
135	1358	1356	1343.79757	1349.30694	-0.1989208	-0.7906436
136	1362	1356	1347.69009	1348.05302	-0.1992198	-0.8287574

137	1363	1358	1350.05044	1350.18671	-0.0381562	-0.7655333
138	1311	1307	1296.54819	1298.31228	-0.5292406	-1.981298
139	1310	1303	1294.79622	1294.38546	-0.4025934	-1.7501359
140	1279	1291	1263.41356	1282.30149	-1.260545	-3.7123081
141	1285	1302	1270.22902	1295.73401	-1.2489668	-4.1149082
142	1454	1243	1433.14024	1231.45565	-46.350685	NaN
143	1249	1177	1232.7762	1166.34031	-7.6136053	-3.7600016
144	1336	1346	1321.62558	1335.16659	-0.372182	-0.3279233
145	2418	2696	2427.60007	2713.96398	-14.396492	-19.264891
146	1946	1973	1936.12141	1971.76978	0.16224431	-0.9167819
147	2029	2068	2020.97509	2064.68009	0.19898414	0.20057644
148	2136	2185	2126.4729	2182.73916	0.18612155	-0.6634252
149	1171	1240	1156.8506	1232.70447	-3.0738648	-6.001706
150	1215	1257	1198.68309	1251.12005	-0.8522327	-2.3805854
151	1308	1364	1294.15666	1357.23868	-0.0964268	-0.766174
152	1530	1657	1515.22914	1650.11407	0.27498341	0.18741202
153	1598	1685	1584.28027	1679.44013	0.19812112	-0.5433863
154	1594	1692	1580.14918	1686.13042	0.21545688	-0.450253
155	1704	1812	1690.81085	1810.19736	0.25365437	-0.3624775
156	1811	1902	1798.39625	1900.20301	0.38037636	-0.4709546
157	1813	1906	1800.36973	1906.67818	0.45821628	-0.3685386
158	1736	1820	1723.12917	1821.48562	0.29743151	-0.5805783
159	1640	1726	1627.23469	1723.95302	0.20969036	-0.6088902
160	1553	1635	1539.56328	1630.8193	0.14609442	-0.451429
161	1496	1538	1483.43469	1531.87043	0.17445207	-0.3426635
162	1489	1509	1475.23339	1505.05817	0.09538023	-0.5554899
163	1476	1526	1461.83145	1520.9464	0.1019173	-0.5059644
164	1407	1447	1391.9238	1441.08198	0.05422194	-0.5373842
165	1337	1360	1322.25548	1352.30589	-0.0040472	-0.6492057
166	1270	1293	1254.27479	1286.67636	-0.1679741	-1.0081806
167	1260	1288	1245.55918	1280.28338	-0.2109767	-0.8874494
168	1202	1233	1186.37435	1226.01585	-0.7888539	-1.9252985
169	1258	1285	1243.30959	1278.01997	-0.1979274	-1.0205674
170	1337	1364	1322.94653	1357.63546	0.00284896	-0.7275122
171	1410	1444	1396.06255	1438.62252	0.0320202	-0.5713953
172	1467	1520	1452.87894	1515.17443	0.12715278	-0.5361582
173	1554	1606	1540.77662	1602.81865	0.13906105	-0.6028556
174	1643	1689	1630.13251	1685.83244	0.26001857	-0.6233171
175	1722	1790	1709.51268	1788.70973	0.26015107	-0.6032435
176	1644	1711	1630.74565	1710.60957	0.20364295	-0.5943015

177	1541	1608	1528.59863	1604.66139	0.14269026	-0.4485656
178	1477	1520	1463.60151	1514.42127	0.17986337	-0.5824263
179	1398	1438	1384.06683	1432.06597	0.12053737	-0.4541929
180	1335	1355	1321.01296	1347.88919	-0.0273857	-0.5671055
181	1255	1282	1239.45721	1273.75981	-0.2126508	-1.0200321
182	1265	1283	1250.51519	1275.46928	-0.1163702	-1.056145
183	1195	1233	1180.20838	1224.60866	-0.7557386	-2.5455316
184	1204	1236	1186.90988	1227.8896	-0.6042646	-2.4071674
185	1262	1234	1243.46862	1226.75629	-3.9681705	-4.3943442
186	1298	1301	1282.4831	1294.78584	-0.7371051	-0.9026874
187	1489	1504	1475.41146	1500.46113	-0.029436	-0.2069169
188	1908	2025	1919.14823	2072.99557	-4.1729056	-5.1493171
189	1725	1834	1713.59907	1835.58766	0.14553233	-0.3422833
190	1810	1965	1799.0455	1969.87101	0.19835927	-0.1892508
191	1985	2170	1974.40236	2185.98179	0.30705681	-3.009041
192	2137	2351	2128.94757	2366.91458	0.30404839	-0.3541229
193	2356	2414	2350.89933	2426.19837	0.35575347	-0.0980696
194	3219	2764	3225.98269	2767.39608	-0.178795	-1.4528019
195	2114	2294	2103.83325	2293.95572	0.55347032	-0.4149802
196	1954	1979	1943.83173	1971.48155	0.3332105	-0.0136233

	Files	**~pressure**
cell 2 - Pt foil	1 thru 107	69
cell 6 - mix	108 thru 196	60

HPCAT 3/2020

File	**log US T**	**log DS T**	**my US fit**	**my DS fit**	**dT/dλ US**	**dT/dλ DS**
1	0	0	1257.02014	1272.31369	NaN	1.70719929
2	1257.63794	300	1107.70979	972.157229	NaN	NaN
3	1245.31789	300	1190.3731	976.98422	NaN	NaN
4	1301.42944	1335.64892	1290.14915	1231.40824	2.28512922	NaN
5	1393.90405	1355.44786	1389.97963	1314.59439	1.9001293	0.73962024
6	1434.35836	1378.48698	1430.32241	1347.58672	1.88299459	0.75377146
7	1502.87826	1453.52575	1501.92163	1445.07646	2.08690465	0.32278799
8	1495.3912	1456.91667	1494.55722	1451.14204	2.04551812	0.35412657
9	1462.85944	1447.94429	1461.56811	1438.72021	1.97523551	0.5744819
10	1436.64797	1401.6435	1433.25107	1396.02416	1.90355434	0.95680838
11	1406.74359	1390.10242	1402.45848	1377.06501	1.92116567	0.72764853
12	1355.86722	1341.65601	1348.67491	1322.03969	1.59098222	1.25533467

13	1388.72401	1385.80912	1382.63777	1370.52413	1.74485741	1.21349571
14	1431.23987	1426.532	1427.66944	1414.65328	1.75817423	0.95176211
15	1457.36213	1476.03465	1455.05579	1470.28107	1.73967969	0.77560848
16	1458.01675	1454.78315	1455.47993	1447.11902	1.62015304	0.94077705
17	1466.44834	1461.82328	1462.49125	1455.83546	1.65567849	0.99821757
18	1489.18554	1475.22773	1487.03476	1472.5241	1.74202679	0.85075089
19	1513.05707	1502.02967	1510.88918	1496.90111	1.70706331	1.04055481
20	1527.21886	1500.83914	1524.31754	1496.6628	1.74738855	0.92403187
21	1557.0289	1534.42352	1556.6141	1531.94317	1.69569605	0.88038316
22	1487.04921	1462.34446	1485.21071	1457.54871	1.64431041	0.94503566
23	1442.68299	1401.07082	1435.60524	1392.72856	1.58331049	1.01382887
24	1409.37589	1380.73371	1400.11767	1369.94998	1.71830354	1.11379169
25	1369.20647	1345.70506	1356.65349	1326.83564	1.87448112	1.39168375
26	1357.02154	1328.60485	1339.12212	1309.88445	1.91708388	1.40506912
27	1343.38868	1299.29218	1322.84561	1280.09085	1.70834927	1.60799929
28	1329.24846	1293.07534	1315.23178	1273.80207	1.60230403	1.433052
29	1305.70941	1265.92526	1286.38019	1239.62126	1.6572831	1.93487029
30	1292.6858	1259.30373	1272.91936	1233.35297	1.85439992	1.79356044
31	1291.19509	1259.12171	1272.2788	1223.86346	2.03606133	2.30280885
32	1275.60887	1245.64457	1267.55284	1233.22557	1.26081544	1.0630532
33	1247.63975	1235.5655	1234.31052	1213.67775	1.9252919	1.81346707
34	1263.54309	1234.6163	1248.32883	1203.55725	0.39892455	1.56606011
35	1251.55069	1231.64207	1231.33113	1203.0772	0.80554423	1.30185206
36	1229.73881	1214.2098	1187.37465	1175.18858	2.17345481	NaN
37	1194.57752	1206.60008	1162.19751	1155.80476	NaN	NaN
38	1361.00974	1769.75129	1273.1331	1547.28727	-35.411966	NaN
39	1375.3921	300	1192.59027	1514.99963	NaN	NaN
40	1251.01709	1273.9874	1248.58845	1268.38755	0.49876742	0.09446606
41	1248.23517	1282.68953	1243.1706	1276.91372	0.71960152	0.09525512
42	1161.55961	1344.08468	1133.95579	1274.57986	NaN	NaN
43	1200.06982	1324.3661	1130.94053	1231.75603	NaN	NaN
44	1082.44586	1246.62352	1108.53762	1227.37613	NaN	NaN
45	1112.13019	1202.89257	1064.39924	1177.20601	NaN	NaN
46	1102.89281	1282.3309	1094.07631	1220.97573	NaN	NaN
47	1207.64808	1258.97517	1130.54121	1197.02737	NaN	NaN
48	1145.30432	1228.0677	1102.46013	1216.17029	NaN	NaN
49	1201.94977	1257.73076	1124.1092	1225.97585	NaN	-1.1428136
50	1167.38912	1253.16217	1135.3576	1223.26328	NaN	-0.1394418
51	1164.84707	1270.87211	1157.31157	1242.48982	NaN	0.68308197
52	1204.04498	1276.6612	1165.06547	1260.98173	NaN	0.30753461

53	1201.50158	1293.63656	1188.92192	1286.63	-2.6999638	0.09819462
54	1189.79061	1264.7699	1166.53504	1257.17071	NaN	0.57370722
55	1164.71107	1242.72585	1065.93553	1219.48168	NaN	0.80690905
56	1260.09626	1230.78164	1173.5955	1192.75259	NaN	NaN
57	1459.47618	1248.03787	1371.05665	1248.89005	NaN	-3.2973147
58	1319.56986	1196.23576	1412.48916	1206.51495	-9.5288741	-0.7155968
59	1472.69047	1204.55383	1339.48805	1203.03893	NaN	-0.8095913
60	1301.8852	1208.68913	1274.81874	1211.7593	NaN	-0.2367904
61	1364.30183	1215.50763	1278.30574	1210.47201	NaN	-0.3522781
62	1323.89556	1210.92199	1337.63393	1199.9694	-16.769199	0.45247431
63	1283.83855	1215.05962	1265.81913	1205.31983	NaN	0.04301302
64	1374.21599	1223.77208	1211.46513	1216.62548	NaN	0.81259584
65	1326.32117	1232.48204	1220.62786	1207.43645	NaN	0.88365746
66	1278.92109	1228.29976	1215.08632	1221.21335	NaN	0.66960271
67	1275.1034	1245.38715	1222.70703	1232.8428	NaN	1.01016869
68	1360.65596	1261.16233	1253.1289	1245.99148	NaN	0.7451665
69	1337.13181	1269.00358	1267.76484	1254.03134	2.44611506	1.38628222
70	1367.37913	1273.4285	1325.48143	1263.31569	-0.0325833	0.76510428
71	1353.21149	1258.16605	1280.68419	1243.54081	3.0428498	0.84095545
72	1342.48452	1269.61615	1330.55183	1260.90819	0.91054937	0.6684431
73	1395.51847	1266.53717	1345.80209	1255.45767	1.56214883	0.9280249
74	1401.28305	1302.85678	1371.581	1297.02447	1.68486026	0.99817321
75	1451.25118	1333.08977	1438.24614	1325.79212	1.49817559	1.24481902
76	1541.54969	1335.66661	1529.08906	1328.83069	1.64756524	1.08641507
77	1553.7525	1326.25036	1533.67673	1321.42489	1.83497024	0.79962619
78	1578.84201	1331.87	1562.70454	1329.58696	2.09406087	0.72901164
79	1550.67077	1305.83983	1528.25506	1298.32847	2.59376366	0.86379627
80	1544.12131	1291.56032	1517.14189	1283.77979	2.35765808	0.78618348
81	1526.8402	1296.71038	1493.33408	1287.10172	2.10858701	0.96341995
82	1510.37875	1287.03073	1481.02792	1275.10543	2.37256295	1.02245374
83	1512.99992	1269.88943	1467.01075	1255.50652	2.43170664	1.14766278
84	1543.42734	1299.98395	1520.27693	1292.46479	2.0942428	0.88200697
85	1566.00593	1321.13122	1553.29746	1314.41183	1.4129061	1.02623336
86	1561.97058	1320.33548	1551.40579	1315.10122	1.74778122	0.75657446
87	1647.94211	1348.01196	1636.62871	1342.25187	2.14211756	0.80083948
88	1670.56197	1354.92412	1658.65916	1350.22236	2.22999994	0.96020526
89	1660.67581	1365.46232	1650.33905	1363.31451	2.37536776	0.77250675
90	1739.13252	1415.35607	1735.3198	1414.02761	2.27467987	0.97625358
91	1705.70561	1530.38206	1704.21665	1531.4783	2.16862242	1.21685991
92	1699.40222	1580.46913	1690.05166	1580.12287	2.22399301	1.68381701

93	1656.2963	1545.76799	1650.27464	1546.63051	2.16748073	1.33573966
94	1561.58118	1506.99922	1548.06088	1505.57814	2.3167879	1.29222724
95	1543.29403	1479.23805	1530.13434	1473.26915	2.5066714	1.23167854
96	1524.90403	1476.63084	1515.26764	1472.08038	2.21327821	1.27646606
97	1456.97572	1413.47225	1436.09795	1405.81785	2.50973971	1.19658152
98	1456.92122	1416.12962	1443.01102	1411.93057	1.96830453	1.07258625
99	1425.8297	1404.55401	1419.42603	1401.16932	1.59137235	0.99170118
100	1405.75291	1380.6827	1391.88714	1374.64536	2.0873575	0.87812473
101	1382.10679	1340.95283	1358.03313	1334.16615	1.93830526	0.76679781
102	1369.47584	1315.84642	1324.92821	1296.87419	2.62334371	0.86800721
103	1356.30921	1296.85429	1366.26955	1291.43179	0.15662808	0.83748023
104	1322.37622	1271.50112	1312.7442	1265.43051	1.21915646	1.77060003
105	1310.72302	1242.09863	1285.61963	1227.16901	0.12510539	-0.2558705
106	1336.10256	1217.61392	1266.17567	1199.26878	4.88112688	-0.2733306
107	1304.19206	1808.18756	1308.60996	1576.01622	-46.628347	NaN
108	1274.17861	1598.17483	1238.61817	1514.10476	-50.08293	NaN
109	1226.17242	1454.07566	1255.82068	1513.52734	-13.524854	NaN
110	1273.1336	1350.85617	1243.53873	1296.03676	-7.2664094	NaN
111	1286.96123	1307.48934	1300.70283	1271.49172	-5.0566114	NaN
112	1468.64415	1300.75617	1460.51141	1265.61133	0.43735087	-2.9592803
113	1490.61091	1334.51015	1492.57485	1337.30819	1.85989816	-0.086306
114	1462.08127	1349.84748	1462.87748	1346.61014	1.68886605	0.46663329
115	1421.77798	1336.85299	1422.75458	1334.13398	1.42738144	0.45354123
116	1380.12466	1326.68359	1378.53375	1316.49859	1.26550194	0.11483836
117	1366.57601	1335.21942	1364.92228	1322.09474	1.08667349	0.516588
118	1368.1041	1332.35452	1367.63503	1322.56079	1.23067166	0.46638081
119	1380.37549	1332.90564	1379.62528	1337.1268	1.36998085	0.51254213
120	1392.63856	1342.16189	1391.72541	1341.04285	1.36064565	0.88445227
121	1352.27583	1342.25159	1350.65083	1319.10342	1.09121147	0.92261934
122	1306.2153	1328.19227	1304.12296	1305.99728	1.08696359	0.56974583
123	1266.246	1299.54303	1268.47764	1273.15177	0.129806	-1.0090075
124	1242.01935	1360.23989	1242.30813	1312.18737	-1.2699807	-2.2710597
125	1215.5526	1503.84418	1186.4634	1325.65328	-6.0533512	NaN
126	1339.73457	1236.40766	1342.30426	1213.15403	-0.6234893	NaN
127	1348.3603	1228.69063	1347.67709	1213.25308	-0.3431564	-1.5160802
128	1345.27118	1255.45898	1344.6769	1222.18976	-1.017738	-4.1299174
129	1359.78738	1244.63303	1369.37978	1221.79046	-0.5845265	-0.9746776
130	1367.51304	1269.53693	1313.33421	1217.50001	1.3157236	NaN
131	1380.76168	1209.73595	1329.10096	1212.50001	1.26418694	NaN
132	1426.15053	1280.19011	1402.22047	1230.73165	1.12804827	NaN

133	1440.29101	1269.01274	1415.34958	1244.06483	1.23090399	0.0925126
134	1489.88653	1294.26443	1472.94598	1272.56216	0.94401868	0.42083393
135	1562.60609	1352.03513	1551.82045	1332.51058	1.11342614	1.13122019
136	1696.51464	1410.35168	1694.84455	1403.48531	1.4372476	1.25713355
137	1717.66633	1429.80805	1718.50047	1429.96752	1.41503178	0.81652584
138	1676.70488	1479.56285	1677.34791	1479.49592	1.1946418	0.83310063
139	1661.41696	1456.13918	1662.30424	1457.99305	1.21258851	0.63180619
140	1629.689	1451.30842	1629.71041	1449.52635	1.02827144	0.73316326
141	1554.74416	1394.63106	1553.26114	1390.60689	1.07081166	0.60281177
142	1528.4856	1384.25297	1525.32409	1374.98851	0.93786578	0.51848072
143	1472.09094	1320.72876	1466.94938	1303.71561	0.88247395	0.93632691
144	1415.23012	1310.59776	1405.15148	1284.10425	0.91246741	0.91953987
145	1374.6702	1258.63829	1358.95088	1216.06665	1.02346505	NaN
146	1340.42221	1265.82321	1314.90189	1194.05821	1.62597843	NaN
147	1316.63462	1280.00552	1273.26336	1179.08493	1.93097013	NaN
148	1301.39578	1260.7915	1284.26597	1210.31694	0.77590232	NaN
149	1275.30388	1307.52865	1278.53806	1233.31696	-1.72883	NaN
150	1285.7049	1229.11135	1277.68013	1217.71262	0.20343126	NaN
151	1337.67199	1253.19431	1327.01871	1230.24457	0.05344665	-1.0031428
152	1360.43166	1296.21889	1347.07766	1252.93823	0.9203885	0.45295348
153	1390.55631	1303.14899	1386.00528	1283.08692	0.72675643	0.37982038
154	1437.13647	1317.89393	1433.51221	1313.31144	0.85310621	0.31579032
155	1466.13747	1347.49559	1465.36005	1340.28512	0.74887159	0.16276273
156	1473.76898	1360.0661	1474.841	1352.1417	0.8066559	0.20371717
157	1498.82918	1369.23174	1497.78275	1368.33916	0.85391793	0.12587784
158	1482.49594	1366.00629	1476.14475	1353.83603	1.1307632	0.38960561
159	1536.9729	1392.2856	1537.99926	1388.31467	0.90935702	0.32029074
160	1558.1323	1417.35361	1557.70284	1417.88092	1.01085301	0.22779373
161	1528.47297	1411.49082	1526.10703	1403.59486	1.095456	0.19474827
162	1569.14731	1436.04113	1567.95598	1431.12686	1.12351211	0.29332136
163	1590.34647	1488.64676	1590.13554	1485.74419	1.0543818	0.32838314
164	1580.72939	1468.58397	1580.30435	1465.96714	1.09512657	0.22525719
165	1581.54412	1440.76735	1581.09331	1437.28512	1.02155846	0.06381562
166	1601.76788	1472.92483	1602.79619	1469.97315	1.05382542	-0.0436136
167	1637.11679	1511.51942	1637.95624	1512.15971	1.13645903	-0.0271318
168	1686.03644	1538.86543	1687.30386	1541.53093	1.24432243	-0.120967
169	1661.94187	1545.49892	1662.289	1543.02843	1.28711234	0.01570539
170	1670.37058	1572.3879	1671.44699	1572.08136	1.30489529	-0.0949677
171	1681.91189	1624.22108	1682.73326	1625.73542	1.33123604	-0.3133429
172	1803.5512	1769.16363	1806.08251	1772.62199	1.6232989	-0.1234535

173	1817.48125	1744.13275	1819.43277	1747.059	1.8393217	0.67083849
174	1841.65134	1681.6505	1844.18898	1683.49897	2.12026772	0.68619323
175	1873.10185	1764.34532	1875.7283	1767.49456	2.54088074	1.40668644
176	1910.09589	1812.96909	1913.73975	1816.3946	2.73419574	1.53673279
177	1835.63338	1790.60165	1837.55744	1792.07009	2.4770741	1.69957842
178	1856.4313	1824.44089	1858.4502	1827.12091	2.50457454	1.76955039
179	1885.85346	1878.26276	1888.72435	1881.70344	2.5422822	1.91664972
180	1868.13263	1840.77209	1870.34849	1843.45034	2.39607458	2.04182256
181	1720.54399	1755.29374	1720.37481	1755.63103	2.15260698	1.79107678
182	1698.07856	1676.89003	1695.12798	1676.03661	2.14974714	1.66168262
183	1675.8379	1734.14181	1677.30342	1737.00136	1.94294165	1.57039748
184	1630.79879	1679.42271	1632.58965	1681.70352	1.99670027	1.693401
185	1615.66357	1661.23298	1617.31749	1663.51939	2.009338	1.65025201
186	1544.46533	1579.42114	1543.71855	1580.51618	1.74300309	1.4374985
187	1531.57963	1597.76835	1530.51956	1597.58197	1.75410271	1.48730871
188	1485.31725	1533.80167	1482.45257	1533.61457	1.6865014	1.44104004
189	1434.05599	1489.07426	1431.86635	1483.42359	1.71622425	1.46260817
190	1430.35194	1482.70195	1426.92646	1476.63481	1.50291317	1.48623235
191	1391.16355	1441.1163	1385.15689	1433.75293	1.31660216	1.45546356
192	1351.81574	1407.19551	1340.17236	1401.0934	1.95473738	1.4693592
193	1315.45969	1364.37704	1288.40964	1349.79049	2.29780219	1.36709761
194	1298.34765	1353.27601	1289.96991	1351.8067	1.69606822	0.94862877
195	1280.72849	1331.84904	1262.92898	1323.20584	1.60016656	0.83641819
196	1258.90133	1310.15821	1241.33553	1306.43565	1.82791848	1.13616236
197	1231.88616	1284.65146	1184.07764	1261.77284	NaN	1.54466404
198	1270.76772	1279.82825	1220.75955	1240.0756	0.61186917	2.2623216
199	1234.53307	1248.09529	1167.26414	1207.0544	NaN	NaN
200	1220.03971	1247.26215	1223.30598	1240.06736	-4.033551	-1.1372924
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203	1249.84102	1162.85035	1229.01409	1156.39123	0.92301522	-0.9907821
204	1208.0707	1148.53103	1201.31377	1162.77895	-2.1347364	-3.8488114
205	1208.28282	1146.05166	1194.69849	1143.76466	NaN	-4.034064
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207	1217.9845	1189.07448	1122.27482	1141.28525	NaN	NaN
208	1233.89789	1205.16017	1133.00466	1161.28677	NaN	NaN
209	1345.81673	1211.53858	1278.18903	1194.09172	0.91722587	0.46699984
210	1332.21688	1232.17935	1303.88474	1222.79667	2.83952587	0.56348228
211	1357.91269	1249.1499	1298.62096	1205.27853	2.50787467	2.40067402
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213	1398.5649	1275.23566	1347.41046	1258.67885	3.24938857	0.95603671
214	1354.85082	1293.33041	1335.89922	1280.16805	3.0072486	1.1281128
215	1331.42817	1253.55983	1267.88777	1213.36363	0.90549174	1.17604858
216	1283.93147	1235.4278	1186.36558	1166.16614	NaN	NaN
217	1307.11323	1188.38436	1212.50001	1124.0788	NaN	NaN
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222	1263.91024	1269.01313	1258.97806	1255.8336	0.1900313	0.0638801
223	1247.92577	1290.01769	1242.48505	1277.41181	0.92220121	0.91563141
224	1290.04799	1316.82036	1276.78902	1313.25648	2.52104878	0.95665497
225	1296.35158	1365.25275	1294.56453	1362.54752	2.6782007	0.96635037
226	1298.21837	1400.61458	1297.62324	1398.82362	2.54423561	0.9347891
227	1338.46145	1459.53509	1338.83442	1459.20432	3.04913872	1.21292596
228	1400.89932	1553.3475	1402.09702	1549.65233	3.09872728	1.42297159
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231	1623.18792	1647.37008	1624.40729	1648.82145	3.8446725	1.87794708
232	1309.30492	1489.47139	1305.08537	1488.87576	2.64017181	1.67073352
233	1466.83861	1545.64746	1461.59313	1541.7771	3.19906815	1.74073873
234	1285.15332	1468.20738	1272.69425	1457.2205	2.23584532	1.76196791
235	1276.09525	1479.24238	1270.3861	1469.44391	2.29958277	1.4891183
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239	1222.59261	1348.63065	1226.8044	1335.21719	1.14469194	0.80665539
240	1228.35131	1345.41876	1225.57795	1336.3618	1.98482021	0.79996208
241	1148.64716	1325.76184	1154.9712	1316.85127	1.13462627	0.34159455
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263	1818.15753	826.338888	1757.62003	733.638838	0.5366548	NaN
264	1860.56057	887.87513	1811.37923	818.722038	-0.7552772	NaN
265	1679.42051	300	1610.36559	751.816849	0.47934108	NaN
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275	1408.70364	1096.80323	1416.94385	1111.05395	-0.5842088	-1.2872034
276	1424.03065	1096.28338	1430.84766	1106.66035	-0.4841311	-1.6593097
277	1464.211	1134.9573	1466.42884	1140.47086	0.06434277	-1.1679775
278	1515.80053	1154.79749	1518.01159	1156.54882	0.24870547	-0.6231468
279	1577.67654	1231.81296	1581.6625	1233.77291	0.56148175	-0.2833028
280	1631.60099	1261.33102	1634.04636	1263.24245	0.74525281	-0.2642849
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282	1798.30371	1370.71661	1802.76785	1372.89005	1.33767475	0.2780097
283	1942.72359	1455.05939	1947.0015	1456.94307	2.16106193	0.44767149
284	1971.58534	1485.86736	1975.88389	1487.58791	2.2566565	0.69530718
285	2213.58443	1518.24906	2217.89971	1519.87415	3.87515222	0.6438671
286	2445.08768	1529.79176	2448.84491	1530.79089	6.59503646	0.45848212
287	2674.17041	1678.51764	2703.1409	1683.05331	4.20659609	0.84385601
288	2384.00654	1940.86224	2753.93258	2002.03225	-2.196175	2.09893541
289	2318.14861	1847.40525	2319.88279	1847.3745	2.50692916	1.35710051
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291	2113.90251	1948.72877	2098.58885	1908.44752	3.4434605	2.87935454
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293	2453.70542	2048.14445	2451.34555	2042.32809	5.8027855	2.46290371
294	2298.34283	1826.0103	2294.52541	1799.49975	4.98089701	1.31087074
295	1952.83995	1650.89872	1869.20937	1512.86229	3.13373992	5.05455623
296	2042.1039	1725.65814	2044.76148	1727.14382	2.22991363	0.90455057
297	1921.23028	1718.88748	1923.0101	1721.18435	2.20564886	0.91863614
298	1956.82009	1629.37254	1956.47134	1628.83884	2.52452705	0.49129529
299	1901.38327	1563.52291	1900.26841	1559.99887	2.43050134	0.50389764
300	1630.9173	1438.58645	1624.52276	1426.1068	1.90553039	0.19848168
301	1675.7344	1532.75545	1667.87535	1521.66453	1.46195339	0.74505773
302	1527.955	1432.91024	1514.56088	1406.52	0.53646202	1.42425561
303	1604.43232	1445.20093	1602.38836	1445.0602	1.52015054	0.35502953
304	1502.34963	1374.47096	1503.64897	1380.54657	1.34626541	0.12000426
305	1365.6927	1221.88101	1396.97057	1241.80706	-1.3656615	-1.6555354
306	1351.79702	1218.66617	1345.51312	1217.79782	-0.083319	-0.5210952
307	1364.16315	1209.76497	1342.71882	1213.68406	1.58377709	-0.1855958
308	1395.53273	1267.26075	1386.21227	1260.36127	0.29324924	-0.1733074
309	1518.83628	1361.3324	1520.93349	1358.53767	0.86890218	0.08225326
310	1558.32122	1385.75119	1557.20922	1385.51536	0.92931586	0.32986655
311	1593.26676	1383.58751	1590.02305	1384.14282	1.12845998	0.55007762
312	1611.88673	1425.01465	1609.77173	1424.72349	1.13988174	0.66614679
313	1689.08807	1457.14005	1688.39499	1456.60548	1.52793717	0.33059078
314	1668.91094	1467.05087	1667.05657	1467.30383	1.26477012	0.72854355
315	1711.02283	1483.73456	1711.30904	1484.99017	1.30166891	0.70174409
316	1745.48236	1499.50391	1743.16406	1500.90129	1.49479812	0.60980966
317	1819.45747	1592.29316	1821.30116	1592.58226	1.73896538	0.77481717
318	1894.91821	1616.10774	1897.74039	1616.87422	1.71259343	0.79986405
319	1934.50713	1675.009	1936.38182	1676.72148	2.30300325	0.89848213
320	1854.00104	1690.73994	1854.98485	1691.82088	1.55906381	0.96223529
321	2157.05656	1920.82313	2161.236	1924.59926	2.44178266	1.76426855
322	2291.7642	1891.84616	2294.87099	1892.47803	3.29808447	1.12495517
323	2195.56894	1965.46021	2198.64285	1967.36933	2.69543418	1.99275354
324	2357.03631	1995.17979	2362.73034	1999.16898	4.44372116	1.06218105
325	2064.29335	1988.85923	2067.68498	1990.89217	3.8026846	2.41525797
326	2349.71521	2238.39395	2357.31445	2244.44586	3.87633457	2.26361666
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328	2035.45216	1760.00375	2000.26763	1661.67602	2.71065856	4.05815648
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343	1461.87184	1519.23532	1456.32989	1517.12305	0.80461106	0.7969233
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352	1275.85067	1295.28671	1287.82031	1297.53065	-1.9500372	-0.3567969
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355	1225.46472	1229.24714	1240.38853	1235.10528	-3.6297363	-1.8130028
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360	1443.50737	1463.22309	1449.27926	1464.42015	0.87732653	0.54132071
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362	1462.50258	1484.30515	1465.47546	1484.90443	0.97672797	0.51665602
363	1521.94554	1510.34624	1522.78663	1510.42922	1.29899791	0.695928
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366	1611.30274	1656.88578	1613.92588	1658.82203	1.61213181	0.95465787
367	1561.73766	1617.76477	1558.73196	1617.95867	1.45469279	0.80263793
368	1583.23881	1611.42851	1581.48409	1611.57454	1.57871627	0.74707716
369	1689.73075	1682.75113	1690.94944	1684.47705	1.64450093	1.11821364
370	1733.80906	1715.024	1736.17869	1716.90863	1.85973749	1.04695141
371	1795.60517	1856.28585	1798.85073	1859.35624	2.1078727	1.20821862
372	1845.03737	1879.96005	1846.59364	1882.99229	2.00798181	1.65077882

373	1780.28109	1848.23752	1782.85161	1848.09171	1.58580444	0.95928815
374	1808.28025	1800.62174	1807.73452	1801.40072	2.08821353	1.77692404
375	2032.15647	2021.77818	2035.43353	2024.66545	2.49531289	2.06524426
376	2034.96196	2120.35475	2038.60728	2124.97922	2.70464913	2.31940975
377	1810.90436	2037.49823	1803.75292	2017.60225	2.36597184	0.85564007
378	1942.04156	1949.81635	1939.75669	1947.96671	2.26553052	2.00088926
379	1996.52461	2123.8727	1995.7528	2122.53469	2.53552073	1.69089141
380	2010.80987	2029.31806	2007.41147	2025.39138	2.37259326	1.74465497
381	2137.51531	2069.14657	2136.64671	2069.77671	2.60985089	2.38829445
382	2121.30876	2234.7278	2122.83527	2237.06108	3.40645055	2.33151089
383	2166.4739	2283.93552	2171.53439	2289.89075	3.01293034	2.72181957
384	2306.44227	2296.31858	2296.95244	2287.06494	5.19373802	3.91518398
385	2141.22341	2200.10481	2129.21668	2166.17265	2.69752156	2.494713
386	2113.97622	2535.96296	2108.41126	2529.60029	3.3849901	3.15807567
387	2159.50102	2688.86144	2159.64322	2688.25162	3.1830888	4.07954387
388	2172.85845	2579.67769	2166.30364	2574.35518	5.11820629	3.14029343
389	2291.79231	2364.98754	2292.36913	2363.93542	2.58897035	2.28033888
390	2224.09694	2309.5884	2213.07739	2293.7576	3.13884692	2.19954899
391	2120.23399	2522.03657	2118.85607	2516.97029	3.20698005	1.24747902
392	2075.86802	2515.38975	2073.22132	2513.89308	3.86642897	3.32993278
393	2239.89314	2074.29877	2215.10333	2054.4789	2.32328509	2.26707669
394	1969.48951	2205.37296	1940.31752	2166.93664	2.64196192	1.69063571
395	1822.30947	1922.40325	1771.46262	1700.3155	4.51797207	6.45706695
396	1949.20718	2247.82933	1953.55269	2254.06373	2.46696506	1.65636864
397	1762.92969	1931.40734	1763.10162	1931.2867	1.74556775	0.63882498
398	1735.66878	1890.5082	1737.27975	1890.0887	0.93924896	1.1511735
399	1566.15342	1730.60388	1574.48629	1734.56365	0.49404437	0.70131291
400	1677.67357	1812.06298	1680.37761	1815.0003	1.33722377	0.43520882
401	1565.33211	1795.84583	1566.08875	1798.36817	1.2580088	0.46113655
402	1567.55817	1661.06149	1565.65629	1664.43509	2.06737549	0.49651092
403	1488.186	1546.76229	1482.05045	1552.69874	0.9437497	0.32325979
404	1326.07551	1424.28033	1344.65614	1442.58665	-0.6768192	-0.5392614
405	1365.81475	1467.18014	1371.36753	1468.79128	-0.0128367	0.32629589
406	1307.45551	1426.78293	1309.23655	1425.92098	0.59640604	0.16012439
407	1244.78991	1331.0956	1253.52674	1339.99282	-0.0306348	-0.5127864
408	1233.35859	1328.60478	1269.45122	1330.3295	-2.1207907	-0.7120547
409	1163.94764	1215.01942	1210.75972	1233.2659	-15.960599	-9.9317715
410	1170.48312	1230.86897	1260.52912	1251.88014	-10.288682	-3.1318771
411	300	300	8555.15906	727.710671	NaN	NaN
412	300	300	6085.34182	6605.075	NaN	NaN

413	300	300	5585.02746	720.775205	NaN	NaN
414	1515.65452	1471.41655	1431.61457	1389.76394	3.22764328	4.04467989
415	1531.09052	1474.00112	1405.4948	1380.63086	NaN	NaN
416	1803.39657	1768.58053	1794.01354	1760.35141	0.48913275	0.49091996
417	300	300	4933.8481	4965.03815	NaN	NaN
418	300	300	778.965735	789.577561	NaN	NaN
419	300	300	937.124079	1007.59961	NaN	NaN
420	300	300	705.986254	965.981358	NaN	NaN
421	300	300	772.598021	1206.89079	NaN	NaN
422	300	300	1026.25015	1167.50004	NaN	NaN
423	300	300	916.893944	996.250687	NaN	NaN
424	1828.96286	1722.44542	1824.32987	1721.51263	0.70133945	1.26714612
425	300	300	758.92915	901.220075	NaN	NaN
426	300	300	763.440071	1031.73193	NaN	NaN
427	1313.1933	1384.65876	1210.39229	1334.95601	NaN	1.65500247
428	1410.76434	1470.13149	1361.28306	1456.2932	3.89591533	1.53282549
429	1514.25248	1565.62741	1499.67697	1560.34181	1.33223272	1.61250895
430	1616.1647	1658.98574	1602.49635	1657.88956	1.06668682	1.65620942
431	1691.09296	1732.21041	1684.56796	1732.09963	1.12014468	1.66885343
432	1745.76983	1794.1093	1747.58559	1796.38179	0.93704801	1.70226333
433	1789.20433	1843.94191	1790.81451	1846.40274	1.00044716	1.78669212
434	1836.39807	1904.22857	1838.90201	1907.23307	1.03520597	1.81940813
435	300	300	1237.10413	2314.99999	NaN	NaN
436	300	300	1611.01337	1987.58139	NaN	NaN
437	300	300	1354.98284	1319.42366	NaN	NaN
438	300	1380.66543	1470.6093	1383.84682	NaN	NaN
439	300	1401.85232	1432.73092	1384.23762	NaN	4.38303521
440	300	1345.93789	1361.53301	1365.37565	NaN	-3.0820438
441	300	300	1861.03232	2224.99999	NaN	NaN
442	300	300	1511.3818	1973.6731	NaN	NaN
443	300	1376.54099	1405.29703	1352.00426	NaN	1.23891353
444	300	1376.34837	1237.67379	1323.42741	NaN	NaN
445	300	1366.10442	946.471762	1233.16428	NaN	NaN
446	300	1334.51279	1421.99923	1361.3961	NaN	-2.0182144
447	300	1333.36647	1130.50343	1359.57005	NaN	-1.4673132
448	300	1324.13349	1468.98183	1328.88137	NaN	-1.9576468
449	300	300	1610.78978	1456.11987	NaN	NaN
450	300	1349.00122	1155.2703	1329.54671	NaN	-2.0294619
451	300	1353.3688	1274.0985	1307.7216	NaN	-1.7223193
452	300	1357.9468	1381.99372	1337.66455	NaN	0.50205683

453	1396.97534	1361.67333	1230.61473	1333.03534	NaN	0.84659644
454	1337.41968	1367.96286	1203.17058	1363.79496	NaN	0.53466263
455	1351.66233	1391.81221	1237.11481	1391.56527	NaN	0.42295363
456	1362.50072	1412.74792	1360.38842	1412.29452	-0.1445728	1.07970676
457	1373.74801	1434.94278	1372.61181	1435.16299	-0.0584973	1.11881157
458	1406.77124	1475.45324	1374.02587	1467.08053	1.47908276	1.0467314
459	1431.92669	1482.04403	1381.55122	1474.22584	1.88885893	1.10345628
460	1450.25229	1517.86749	1446.3796	1518.29804	0.34773168	0.71459984
461	1468.51479	1556.03568	1456.52284	1551.76779	1.41594954	1.08510423
462	1511.74714	1587.88413	1495.99246	1586.46247	0.79052196	1.16070016
463	1516.4007	1595.08934	1507.07684	1592.6191	0.73823566	1.04841409
464	1555.41715	1641.39597	1551.85811	1640.27039	0.74378188	1.13691556
465	1575.35818	1663.64886	1570.07968	1662.40361	0.83907874	1.12147745
466	1607.64363	1695.82149	1604.42814	1696.84383	0.74612351	1.21480005
467	1660.78475	1751.62054	1661.04011	1753.48886	0.7481144	1.28651285
468	1684.8171	1772.80545	1681.55677	1774.68057	0.85275504	1.31358489
469	1720.92478	1815.7786	1722.99814	1818.82547	0.63343329	1.3381254
470	1748.04199	1848.61291	1750.35135	1851.48727	0.54747589	1.30772989
471	1525.96282	1615.60204	1512.53722	1615.51695	0.33982751	0.7214521
472	1680.95751	1821.71258	1680.2676	1823.86995	0.15196109	0.85690346
473	300	300	5812.2474	4745.00085	NaN	NaN
474	300	300	6686.01852	8004.95114	NaN	NaN
475	300	300	5625.05053	711.126045	NaN	NaN
476	300	300	640.055934	704.976336	NaN	NaN
477	1215.64456	1400.19493	1055.66946	1221.81104	NaN	NaN
478	1226.94467	1488.73975	1186.533	1450.52784	NaN	1.06116814
479	1504.61559	1867.61069	1501.83867	1865.51042	3.08112721	0.30049877
480	1536.9282	1944.88265	1536.38438	1947.40766	2.52795987	0.38958528
481	1605.37472	2051.71395	1607.49215	2055.27601	2.40749027	0.4399828
482	300	300	10782.116	747.887693	NaN	NaN
483	300	300	700.40786	705.957667	NaN	NaN
484	300	300	5412.40315	8049.97352	NaN	NaN
485	300	300	748.562378	717.81503	NaN	NaN
486	300	300	803.63006	709.045751	NaN	NaN
487	300	300	736.072024	740.662528	NaN	NaN
488	300	300	704.077092	746.72918	NaN	NaN
489	300	300	681.331616	735.86384	NaN	NaN
490	300	300	676.644791	781.935395	NaN	NaN
491	300	1273.82524	730.941814	958.96679	NaN	NaN
492	300	300	757.569808	961.526041	NaN	NaN

493	300	300	641.857568	926.024762	NaN	NaN
494	300	1424.57462	900.14813	1337.1385	NaN	NaN
495	1374.07411	1527.94789	1042.44465	1480.37002	NaN	0.69520561
496	1325.41562	1540.56958	1140.30343	1487.32614	NaN	0.62358056
497	1448.49653	1635.53723	1282.84797	1603.8503	NaN	0.07893556
498	1505.34281	1725.46176	1425.05079	1708.8947	2.35011462	-0.2213019
499	1599.1934	1822.5941	1540.49074	1814.64594	0.87648549	0.02163332
500	1644.42885	1919.43823	1615.98615	1916.93493	0.57385311	0.43116014
501	1776.67706	2044.87621	1766.08903	2046.55784	0.15215859	1.02102069
502	1892.11796	2180.3558	1893.54928	2183.97038	0.0128529	1.27606366
503	2096.44512	2327.34516	2103.03148	2343.67377	0.14746143	1.47456807

	Files	**~ pressure**	**notes**
cell 3 load 1 - Pt foil	2 to 37	25 GPa	
	38 to 41	45 GPa	
cell 4 - Pt foil	42 to 106	28 GPa	
cell 5 - Pt foil	107 to 202	48 GPa	
cell 2 - Pt foil	203 to 244	60 GPa	
cell 3 load 2 - Pt foil	245 to 270	60 GPa	
	271 to 410	60 to 70 GPa	
Not our sample	411 to 419		not included in the two-color analysis
cell 1 - mix	420 to 472		
cell 6 - mix	473 to 482		
cell 3 load 2 - Pt foil	483 to 503	60 Gpa	

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File	log US T	log DS T	my US fit	my DS fit	dT/dλ US	dT/dλ DS
1			0	0	NaN	NaN
2			0	0	NaN	NaN
3			0	0	NaN	NaN
4			0	0	NaN	NaN
5			0	0	NaN	NaN
6	300	300	964.861164	1933.0295	NaN	NaN
7	300	300	853.239272	1576.06164	NaN	NaN
8	1144.34825	1188.67703	1104.39554	1156.0062	NaN	0.38859941
9	1133.00671	1176.60048	1102.14943	1165.95966	NaN	-1.0844563
10	1154.52962	1201.33773	1105.72318	1184.14774	NaN	-0.2779646

11	1112.4026	1206.34318	1090.34952	1194.43409	NaN	-0.2517236
12	1231.7126	1245.76948	1178.18585	1234.38336	NaN	-0.2129646
13	1320.85467	1294.73082	1310.18929	1292.51282	-1.2305144	0.60736183
14	1428.13475	1326.42758	1427.38647	1322.08737	-0.8538302	0.59142106
15	1684.31906	1444.35108	1684.45305	1443.72603	0.71569244	0.62721455
16	1834.66926	1528.66814	1836.5478	1530.72922	1.83017815	0.99874519
17	1781.32403	1549.41556	1782.48893	1550.73646	2.98678647	1.01935196
18	1800.98109	1546.59586	1801.263	1547.86657	2.71754223	1.01777118
19	1805.61694	1516.54291	1806.49619	1517.90568	2.99128343	1.04221139
20	1782.9823	1490.30204	1781.35464	1491.04972	3.47756126	1.14126102
21	1737.91475	1492.03773	1736.15908	1493.07359	2.68520694	1.14868126
22	1711.355	1441.40168	1711.97989	1441.52605	2.36217258	1.16180977
23	1680.48964	1413.49949	1680.19015	1413.88949	1.64320264	0.94117378
24	1621.88574	1412.29563	1619.52831	1413.17585	1.31932916	0.98314777
25	1604.16558	1364.96874	1600.15866	1364.11351	1.82793517	0.87590896
26	1519.63803	1279.89007	1489.35895	1272.20381	2.12489821	0.8832565
27	1523.58274	1278.22082	1502.52282	1270.95463	1.94572385	1.04147582
28	1393.84946	1223.15546	1357.43318	1214.91031	2.18719384	0.672665
29	1333.13183	1200.10859	1257.56133	1173.62581	NaN	0.34733158
30	1464.49752	1513.62284	1450.92901	1513.99417	-0.8505541	-0.6556244
31	1392.12062	1438.40379	1371.5741	1443.66195	-2.3804391	-1.8615758
32	1339.78715	1418.47104	1276.59477	1402.23746	-8.8553373	-2.497422
33	1242.60205	1384.8065	1191.41187	1372.56402	NaN	-2.6501694
34	1293.4652	1369.78707	1231.35636	1358.31693	NaN	-3.3927178
35	1363.19436	1395.07864	1341.46637	1394.29815	-2.93651	-3.0085474
36	1408.89529	1402.27167	1363.20197	1382.91607	-0.4305206	-0.946786
37	1471.75472	1406.23792	1443.48957	1404.97277	-1.7071872	-1.0930165
38	1587.08963	1480.44468	1574.69801	1479.31706	-0.4537837	-0.0328586
39	1606.02147	1494.05751	1598.55689	1492.4685	-0.507927	0.09090947
40	1605.55375	1494.20918	1594.8521	1490.20295	-0.2185856	0.13352256
41	1694.24083	1518.87011	1691.31044	1519.96169	-0.3644598	0.43220004
42	1761.01062	1589.69812	1759.45852	1590.71704	0.42942966	0.10717218
43	1731.90019	1546.36821	1723.61927	1547.99324	0.18521573	0.23927764
44	1820.2773	1625.89674	1817.30233	1626.33991	0.57984234	0.18567874
45	1967.45552	1655.02082	1965.94093	1656.73524	0.8768548	-0.3202057
46	1872.68599	1632.16776	1865.54448	1630.44604	-0.0337664	-0.248014
47	1838.60783	1583.74153	1834.85608	1585.52813	-0.7369621	-0.3360649
48	1718.55813	1595.98214	1695.22323	1594.97662	-0.4585092	-0.236139
49	1966.6832	1563.05545	1966.37782	1565.66757	1.34382805	0.13786776
50	1849.47797	1467.75884	1847.23923	1465.62581	2.17293836	-0.0428219

51	2151.90968	1822.2309	2155.01004	1825.97191	-2.0917975	-1.0135069
52	2185.11619	1856.8572	2188.49468	1860.43591	-1.9355365	-1.0383633
53	1997.36177	1764.33281	1997.84801	1766.90174	-1.6442392	-1.0019763
54	1763.28952	1567.58942	1754.98277	1567.55588	-1.158971	-0.9339195
55	1771.45029	1594.6216	1768.24225	1594.60674	-1.2589875	-0.9247006
56	1618.5448	1473.07161	1613.3334	1470.34154	-1.1557393	-0.8258589
57	1525.91686	1393.30663	1519.47256	1387.28683	-1.2728284	-0.6428437
58	1517.39551	1398.66417	1503.13849	1394.47501	-0.2145373	-0.8971575
59	1511.19112	1377.44543	1509.54746	1374.67453	-1.4902572	-0.939014
60	1482.28773	1342.93087	1473.03816	1339.13608	-1.4272439	-1.4979798
61	1469.54888	1334.3512	1448.73197	1330.58592	-1.1717496	-1.1849614
62	1397.30203	1312.30409	1396.59135	1294.72918	-2.7486116	-3.2617847
63	1406.17101	1301.25065	1397.32515	1295.52981	-2.9270615	-2.6759926
64	1348.8607	1250.3787	1362.05645	1263.37955	-2.8761798	-2.9793408
65	1457.04411	1324.11331	1436.93217	1315.00083	-0.8535602	-1.2690887
66	1567.08009	1388.77278	1562.05242	1385.59363	-1.0331254	-0.773564
67	1618.87016	1430.49007	1619.15239	1430.33465	-1.0194671	-0.6574532
68	1614.80345	1425.49436	1614.81429	1426.30839	-0.8991164	-0.4996834
69	1776.98327	1527.48834	1777.94453	1529.35594	-1.1468227	-0.5377336
70	1897.62172	1601.58791	1899.9872	1604.59594	-1.0840123	-0.5797373
71	1823.81991	1566.21761	1824.32051	1568.35437	-1.0036018	-0.4871927
72	1775.22383	1522.57931	1785.0415	1523.59686	-1.0213808	-0.4880277
73	1952.19221	1621.76828	1953.84468	1623.89064	-1.4359782	-0.4580136
74	1982.07146	1640.40611	1983.19602	1643.14571	-1.2899301	-0.3857476
75	1938.13182	1598.33655	1937.69333	1600.33514	-1.1647049	-0.4450545
76	2066.68136	1675.62972	2069.61806	1679.07239	-1.1996944	-0.3339203
77	2021.66813	1658.61068	2022.59968	1656.85898	-0.9742374	-0.2167196
78	2031.19747	1676.12694	2028.6104	1676.91544	-0.7661415	-0.0561393
79	2006.56401	1648.13094	2008.84288	1646.50282	-0.8909553	-1.0611759
80	1927.41272	1643.11406	1925.56118	1642.12611	-0.6349247	-0.5540281
81	1996.13842	1692.23161	1996.99555	1690.77861	-0.6696073	-1.2523901
82	2076.6769	1719.82294	2078.02445	1720.86243	-0.3849597	-0.59204
83	2154.26235	1792.4426	2157.27353	1796.62658	-0.289373	-0.9329697
84	2362.79719	1957.61642	2367.72882	1962.74641	-0.5429939	-0.3130947
85	2551.49676	2104.80357	2556.3843	2108.63785	0.05504949	-2.2468738
86	2148.19587	1855.69194	2149.0359	1852.58731	-0.362558	-0.2837237
87	2089.36823	1792.31597	2089.0705	1789.44416	0.09700987	-0.3298297
88	2132.61834	1785.80829	2133.63524	1782.58509	0.11721389	0.03906519
89	1965.30797	1682.53771	1964.5446	1674.42616	0.53724783	0.28557823
90	2322.08058	1965.56204	2326.30859	1968.48946	-0.016061	-0.9607133

91	2023.53906	1771.08758	2023.2672	1763.12142	-0.0155172	-0.3665745
92	2264.70827	1964.5196	2267.07492	1964.54704	-0.5895684	-0.7964738
93	2346.30244	2056.81393	2350.1034	2060.88091	-1.6554418	-0.4855802
94	2423.72649	2203.35303	2427.62303	2207.46443	-2.5639056	-1.7911152
95	2363.45586	2166.56616	2368.32219	2172.27675	-1.588337	-0.5669902
96	1967.31605	1833.3283	1940.27079	1787.06696	1.48156244	0.9328454
97	2224.49976	2048.45072	2227.37847	2050.75271	-1.7184205	-0.9320684
98	2012.60335	1824.49337	2014.31782	1823.65085	0.12405341	0.04227257
99	2071.99143	1905.6094	2073.78888	1906.33641	-0.2728141	0.26223189
100	2053.88995	1940.34029	2057.04188	1943.43846	0.77543454	0.02770847
101	2109.56649	1917.67502	2112.78693	1920.24859	0.5038408	-0.580516
102	2234.72633	2170.90931	2238.62138	2175.87032	2.32834742	-0.9316012
103	2153.90001	2057.13905	2156.99435	2059.92117	-0.2407053	-1.0762025
104	1999.98689	1865.61423	2001.4848	1865.11697	0.63021305	-0.5765197
105	2228.21965	2008.23472	2229.48224	2007.48298	-1.1589534	-1.8813891
106	1807.44056	1752.9718	1802.11206	1732.48551	-0.9118918	-0.6851755
107	1735.92962	1614.52316	1734.74972	1611.73116	0.54703404	-0.7233513
108	1747.36956	1715.72369	1747.2721	1709.44849	0.37171546	-0.7834012
109	1595.44889	1545.93067	1591.52206	1536.82667	0.13966703	-0.4591033
110	1605.57022	1628.42846	1605.44266	1628.48263	0.48867941	-0.9039256
111	1653.60838	1572.60581	1652.70428	1574.25744	0.02406842	-0.3620499
112	1625.26632	1550.48179	1621.99832	1549.39357	0.24256302	-0.3943311
113	1514.84741	1501.64679	1509.92753	1496.88325	0.13926887	-0.248502
114	1576.43684	1545.44111	1569.61544	1542.06907	-0.1443613	-0.6594435
115	1564.68109	1499.73402	1561.52697	1499.09313	-0.385903	-0.6574298
116	1469.25206	1424.8221	1466.02555	1424.29502	0.03121282	-0.1286758
117	1424.72348	1429.16303	1414.6267	1421.46199	0.26294956	-0.0385743
118	1398.20803	1375.53941	1387.23205	1366.87566	0.24614543	-0.1770391
119	1379.35018	1342.8509	1374.30076	1334.92319	0.15290601	0.02504461
120	1351.13636	1300.29182	1314.52055	1281.59951	0.80132313	0.29849488
121	1322.77076	1296.04203	1313.43765	1284.81268	-0.0605695	-0.4575401
122	1307.73499	1272.39684	1277.97441	1256.91493	0.11842173	-0.2591694
123	1275.43302	1259.52462	1244.01145	1240.0156	-0.3412906	-0.7743468
124	1221.83908	1235.38567	1186.35495	1226.81951	0.46544788	-2.2604458
125	1208.29989	1264.43681	1176.37515	1207.25718	-2.7132157	-3.5226301
126	1140.47103	1265.54285	1101.78701	1205.77438	NaN	NaN
127	1203.17956	1248.00832	1153.26415	1229.25339	4.73249964	-4.7766888
128	1200.00248	1224.56324	1165.51583	1218.07076	-3.2697958	-3.8538864
129	1189.10629	1224.40545	1174.81804	1230.4239	-13.581543	-6.8370569
130	1469.82173	1446.61367	1467.84	1443.57922	-0.0280162	0.35772871

131	1413.58501	1388.12466	1409.58884	1379.83882	0.05770861	0.3978401
132	1370.27559	1348.9926	1364.0053	1334.26546	0.01384542	0.15171362
133	1343.86318	1310.51968	1337.88846	1301.35925	0.18540426	0.60117072
134	1309.29232	1258.7489	1299.49523	1231.00614	0.56931097	0.40737195
135	1285.05317	1231.03871	1275.07416	1197.09882	0.72531841	-0.1207842
136	300	300	752.659622	1484.36583	NaN	NaN
137	300	300	1319.77195	1483.53892	NaN	NaN
138	1196.14944	300	879.546916	894.388157	NaN	NaN
139	300	300	821.302409	914.840361	NaN	NaN
140	1119.78381	300	882.174221	1034.94886	NaN	NaN
141	1187.23207	300	985.325141	964.979165	NaN	NaN
142	1031.74917	1411.59927	1110.76545	1608.64474	NaN	NaN
143	1094.41044	1456.00243	1164.78324	1585.21622	-10.411052	NaN
144	1106.28819	1459.74335	1138.52015	1597.20564	NaN	NaN
145	1118.66939	1330.36921	1156.38642	1514.54686	-6.8236768	NaN
146	1130.34676	1313.18749	1148.24264	1514.36248	-2.7293505	NaN
147	1164.52299	1258.25011	1174.90794	1513.85671	-3.3496014	NaN
148	1174.67791	1237.47985	1184.09305	1413.31577	-2.206781	NaN
149	1186.50376	1206.01396	1194.95213	1255.49739	-0.4578531	1.53510701
150	1195.25857	1236.67341	1200.5487	1255.45045	-0.1583204	NaN
151	1218.1403	1244.56287	1223.2142	1263.66348	-0.195044	-39.283996
152	1265.36194	1237.24547	1272.06327	1273.96955	-0.3740498	-6.5365133
153	1275.65104	1224.1102	1282.93991	1268.07312	-0.2812856	-9.2969902
154	1302.16255	1269.27326	1310.53449	1248.0396	-0.3220669	-3.859991
155	1340.26076	1235.55254	1344.67276	1255.67838	-0.1113129	-3.6432832
156	1339.87018	1232.67445	1342.85346	1254.99141	-0.1567863	-2.119173
157	1356.4559	1236.60602	1359.10806	1248.14427	-0.0016218	-1.9644717
158	1309.22474	1229.03916	1315.88092	1256.43769	-0.3808647	-4.3917154
159	1342.7983	1226.41071	1346.06724	1244.64315	-0.0877871	-2.2529601
160	1346.58945	1233.56623	1349.48196	1251.91444	0.08394246	-1.8124813
161	1362.39511	1245.09912	1365.2423	1261.58102	0.15918923	-1.3879241
162	1386.70323	1265.57203	1388.18595	1274.16514	0.13473897	-1.0267032
163	1384.65671	1270.96503	1386.40663	1282.50143	0.17600765	-0.6660257
164	1396.10282	1287.19887	1396.95009	1295.89473	0.18166011	-0.2692817
165	1393.60232	1299.12916	1392.02083	1287.51488	0.33920008	0.77942439
166	1394.1394	1304.42965	1393.24929	1297.58198	0.3102087	0.57150758
167	1407.88421	1322.42356	1407.54972	1313.55929	0.26145781	0.50963804
168	1404.71211	1351.97578	1404.17265	1348.98693	0.3481377	0.29611799
169	1434.47593	1350.99513	1434.62132	1347.06736	0.31371361	0.48738761
170	1447.60444	1389.64121	1447.64326	1387.91896	0.32183487	0.56674678

171	1445.81313	1374.87683	1444.65764	1367.65786	0.2406577	0.6605133
172	1424.28629	1390.79902	1423.52485	1385.55689	0.28008853	0.51472176
173	1420.02186	1366.54019	1419.99854	1361.57504	0.25962192	0.61258812
174	1429.24947	1382.40753	1428.89687	1377.67094	0.21184726	0.49685099
175	1451.69079	1410.59728	1451.60455	1408.34994	0.2038692	0.51880109
176	1463.2625	1418.87855	1463.38436	1416.4788	0.3377838	0.57698716
177	1511.29344	1424.51434	1511.1149	1422.18672	0.18218825	0.58793687
178	1414.40675	1404.66248	1411.26639	1393.64358	0.27695021	0.69088593
179	1462.20398	1475.55304	1460.06429	1472.04794	0.05513762	0.72419173
180	1470.90096	1442.52817	1467.42586	1435.84031	0.19249417	0.65753328
181	1500.77411	1474.33973	1498.50337	1469.17521	0.15994533	0.6453897
182	1500.71412	1448.33714	1498.86859	1443.86559	0.17806241	0.69694548
183	1471.66594	1486.07509	1469.40409	1482.34411	0.2265191	0.8185991
184	1460.73383	1504.723	1460.46266	1502.12021	0.1991522	0.85537269
185	1463.61181	1529.7043	1462.30912	1529.11281	0.00988514	0.88404592
186	1546.89705	1521.22005	1546.61907	1520.17843	-0.0454842	0.99582806
187	1498.84276	1542.82327	1497.32266	1542.09588	0.04697847	1.05511393
188	1471.44321	1590.38273	1469.32624	1590.45947	0.02638239	1.57833852
189	1544.3086	1534.71675	1544.26198	1535.51201	-0.0362891	1.09858636
190	1485.44962	1546.4796	1484.81399	1547.37434	-0.2686843	0.99836479
191	1545.54491	1553.65078	1545.19642	1554.27811	-0.2259032	0.88337132
192	1515.17436	1436.57039	1514.52015	1435.17376	0.26593568	0.77040898
193	1584.9533	1565.58403	1584.57717	1566.31951	0.13574028	0.68529896
194	1570.01551	1498.72273	1568.23685	1498.3252	0.43077732	0.81946509
195	1701.87333	1551.33064	1702.80944	1552.57545	0.38847006	0.91781363
196	1611.87458	1531.77962	1609.5102	1525.47408	-0.3718039	0.82315891
197	1635.66109	1633.75435	1634.65657	1631.10241	0.4811915	0.86138424
198	1679.45822	1575.21394	1676.28381	1572.67629	0.1630531	0.93923365
199	1647.44605	1644.92803	1646.26195	1644.61041	-0.3754684	0.97788883
200	1595.25193	1531.32131	1590.5755	1522.97132	0.9661157	0.99541862
201	1727.16113	1540.05154	1727.44235	1539.38213	-0.9047729	0.91215394
202	1677.95427	1542.08355	1675.54017	1536.53519	0.55469203	0.35310751
203	1495.23862	1470.6865	1488.76565	1458.83225	-0.2887875	1.03150137
204	1668.69661	1504.87706	1665.87821	1497.66842	0.29871092	1.15150097
205	1756.08911	1368.86772	1747.94965	1359.46248	0.78451607	0.71565309
206	1699.27062	1467.79186	1698.24925	1462.1892	0.45428813	0.84133038
207	1610.01236	1518.27254	1606.65276	1515.3688	0.06060075	0.76124375
208	1473.22585	1481.00545	1468.17005	1468.74127	0.13751998	1.16185314
209	1810.33322	1542.48139	1810.49259	1540.77651	0.89699142	0.8336126
210	1741.14656	1543.64788	1738.93717	1539.41816	0.46793547	0.91471454

211	1742.46636	1691.61741	1743.24864	1691.67313	0.31331345	0.89522604
212	1735.28942	1604.45297	1732.66762	1601.04873	0.65747088	0.88133092
213	1810.25705	1553.91395	1809.22515	1549.94544	0.62091642	0.90525252
214	1729.6363	1567.8729	1725.70678	1566.10327	0.71173582	0.69067184
215	1798.52569	1681.06841	1799.12758	1680.59727	0.83123682	1.03843134
216	1926.16248	1769.76133	1928.08244	1771.76036	0.809379	1.33525743
217	1831.9281	1708.65078	1833.13483	1709.47541	0.7442389	1.06706001
218	1752.56793	1606.12202	1750.39837	1600.57459	0.70034199	1.03740905
219	1898.51253	1714.69922	1899.84098	1714.765	0.72738265	0.99445623
220	1734.42746	1844.24999	1733.86603	1844.91404	0.46647891	1.07611087
221	2001.97264	1637.13224	2003.32135	1636.10803	1.26107548	0.69328815
222	1940.22021	1712.97947	1941.05775	1713.26934	0.35259874	0.96783565
223	1868.3062	1688.93627	1869.152	1687.8798	0.48933752	1.35556315
224	1901.96254	1934.82681	1903.79372	1937.10863	0.48053257	1.36419735
225	1863.38549	1720.09104	1863.23825	1718.25647	0.49213563	0.82036122
226	1855.62132	1786.7426	1855.72917	1785.66795	0.52053921	1.07218013
227	1762.93465	1734.2053	1762.83598	1732.47316	0.36919895	0.78242023
228	2115.08859	1742.67062	2116.96567	1743.62342	0.49230587	1.02477375
229	1777.94112	1704.797	1778.21899	1703.39264	0.83491325	0.90462608
230	1839.83396	1990.15397	1841.13498	1992.52893	0.24098877	1.14657157
231	1897.13517	1999.78459	1897.5268	2001.3124	0.53811409	0.89291169
232	1989.88846	1856.63235	1992.66969	1859.2846	1.67878496	1.11137794
233	1927.65132	1832.92272	1929.88935	1834.94991	2.05309238	1.08595158
234	2056.88855	1948.77749	2060.21861	1952.21988	1.18229858	1.00464678
235	1935.75612	1878.12496	1933.0955	1874.69016	0.75767258	1.39355875
236	1732.12953	1747.23155	1722.22558	1736.58503	1.1827028	1.600736
237	1500	1978.67344	3454.13645	1997.31833	-10.486719	1.49816909
238	1979.63901	2040.18775	1964.35783	2027.0039	2.89950805	1.80984272
239	2251.93289	1978.99227	2245.01308	1970.02674	4.00463529	0.99111184
240	2518.79295	1995.91058	2523.71727	1994.99447	4.08210734	0.77300743
241	2368.03824	2228.01371	2371.36451	2230.66341	3.65475506	2.62873555
242	2209.35544	1870.08812	2198.51332	1849.7164	2.54005552	2.17396812
243	2020.49779	1974.29411	2013.60971	1966.30008	1.8632942	1.78296419
244	2021.26991	1730.11599	1996.16729	1547.86301	1.1681068	2.5683172
245	1500	2134.65029	3361.95452	2169.3727	4.08949642	-0.3917618
246	2308.83292	1704.17283	2309.02679	1697.83553	-0.0523721	0.79571545
247	1869.54531	1717.8392	1866.03304	1708.35698	0.88554106	1.20011811
248	1883.86787	1763.61861	1873.69278	1753.07828	1.65208382	1.60081423
249	1778.89872	1548.73274	1770.77733	1511.76047	1.38129039	2.03861225
250	1807.40271	1580.62824	1800.82163	1529.32831	1.95535632	2.32763395

251	1877.4595	1441.84914	1876.3953	1422.2582	3.34376781	0.94345878
252	2022.89375	1925.68184	2025.96127	1927.76057	1.45987333	0.5867555
253	1650.0017	1578.97955	1636.2583	1553.05339	1.52293834	1.02082135
254	1730.39317	1516.68034	1724.74465	1495.02236	1.34019674	1.25245371
255	1673.97749	1378.22756	1660.08061	1338.37998	1.48091704	2.28136263
256	1695.19977	1433.59734	1689.4045	1415.62777	1.23957503	0.94624803
257	1697.63477	1410.11701	1687.0381	1382.81029	1.81873933	1.27316806
258	1553.10647	1481.59859	1533.64794	1449.77401	1.92815315	1.36445315
259	1585.56606	1410.9068	1576.15034	1394.01106	0.90882269	0.99073397
260	1533.50241	1305.92695	1505.86358	1272.22282	1.38521602	2.05264638
261	1509.27404	1397.56907	1491.83412	1367.78546	1.46113137	1.33931239
262	1438.81425	1294.43392	1398.37034	1241.39566	1.85464828	NaN
263	1357.86071	1293.81544	1321.84252	1260.56109	2.20512808	1.67048074
264	1316.6655	1270.30683	1268.04843	1221.13913	3.39677449	NaN
265	1322.53752	1292.72837	1265.2376	1180.80357	3.39825978	NaN
266	1308.88561	1287.03684	1245.68552	1234.5274	NaN	1.15182039
267	1272.94057	1195.07008	1168.12019	1089.65478	NaN	NaN
268	1233.61742	1212.3106	1097.55687	1089.06189	NaN	NaN
269	1192.11555	1248.69701	1036.25007	1049.05075	NaN	NaN

	Files	**~pressure**
cell 3 - Pt foil	6 to 29	70 GPa
cell 2 - Pt foil	30 to 50	65 GPa
cell 5 - mix	51 to 129	56 GPa
cell 4 - Pt foil	130 to 269	65 GPa

HPCAT 10/24/2020

File	**log US T**	**log DS T**	**my US fit**	**my DS fit**	**dT/dλ US**	**dT/dλ DS**
1	NaN	NaN	0	0	NaN	NaN
2	300	300	784.425904	1636.75329	NaN	NaN
3	300	300	786.348752	1576.21309	NaN	NaN
4	300	300	1989.91675	2088.13866	NaN	NaN
5	300	300	2132.19861	2747.99997	NaN	-122.02158
6	300	300	1838.6688	1932.96077	NaN	NaN
7	300	300	1616.0425	1667.08547	NaN	NaN
8	1432	1230	1292.65433	1213.11627	NaN	-2.1866803
9	1314	1242	1301.88196	1229.35356	NaN	-3.2078798
10	1328	1246	1295.77896	1230.08655	-7.5494488	-2.9560813
11	1299	1245	1355.86881	1219.86786	-7.674966	-1.9807692

12	1309	1230	1291.08022	1234.98268	-8.5117684	-2.282073
13	1376	1237	1349.67115	1224.5016	-4.5888805	-1.7256056
14	1322	1231	1312.79368	1220.80321	-1.5560145	-1.481858
15	1346	1250	1330.76236	1242.75516	-0.9920528	-0.9382248
16	1385	1280	1377.45298	1279.19054	-0.8902802	-0.2464421
17	1429	1320	1428.64019	1318.30959	-0.343798	0.00884344
18	1417	1319	1390.25253	1310.28089	0.52074988	0.08225913
19	1495	1349	1478.2562	1343.44462	-0.2219586	0.33042547
20	1494	1351	1480.92138	1346.18629	-0.154897	0.3749111
21	1500	1370	1484.61414	1361.45559	0.12670765	0.51305426
22	1588	1428	1582.98371	1425.6438	0.08081999	0.54559511
23	1556	1431	1546.23379	1428.16972	0.15829222	0.54782192
24	1603	1466	1602.28857	1464.98334	0.02638193	0.67102722
25	1633	1477	1632.30028	1476.8786	-0.0501601	0.59001839
26	1632	1455	1631.57846	1454.29032	-0.0228283	0.67021802
27	1695	1521	1694.35164	1520.31411	0.07798106	0.77168719
28	1668	1531	1667.60539	1531.29918	0.08197364	0.85473303
29	1711	1549	1711.28804	1549.4736	0.14884676	0.75008264
30	1722	1583	1722.22418	1581.07749	0.08825594	0.95576485
31	1745	1573	1746.75991	1573.81896	0.10183702	0.85806308
32	1685	1517	1684.82989	1516.64571	0.06163583	0.78196884
33	1634	1491	1634.65068	1490.269	-0.0439793	0.81159187
34	1605	1453	1602.74722	1453.82585	0.14370891	0.68856822
35	1575	1438	1575.44904	1435.71591	0.03735237	0.7176376
36	1523	1375	1519.25081	1371.4333	-0.01235	0.61820034
37	1501	1370	1490.60235	1365.10064	0.15007325	0.74070911
38	1472	1317	1461.73605	1309.35856	0.02392356	0.6310335
39	1436	1334	1419.89778	1323.30506	0.48689799	0.73794314
40	1381	1274	1359.00049	1254.34335	1.12546692	1.11562503
41	1387	1269	1376.3155	1256.77744	0.16743561	0.59120359
42	1370	1263	1348.43835	1251.50573	0.22314637	0.55449234
43	1329	1259	1296.80149	1237.28352	0.78166521	-0.0968522
44	1332	1233	1324.96222	1219.06826	-0.3592908	0.00756201
45	1296	1225	1275.3229	1206.83504	0.36454801	0.05483596
46	1279	1211	1238.66248	1189.1753	1.37085224	-1.138554
47	1265	1200	1247.75815	1165.21202	-1.8804475	NaN
48	1220	1187	1169.28694	1164.99195	NaN	NaN
49	1219	1199	1281.06863	1262.92078	-8.9278574	-11.836644
50	1223	1195	1272.04052	1243.5142	-6.9158683	-2.1485218
51	1286	1419	1337.38285	1513.97875	NaN	NaN

52	1088	1353	1224.0943	1513.85201	NaN	-14.885536
53	1222	1452	1514.13499	1515.70561	-63.257574	6.65253973
54	300	300	1636.25825	2508.04972	NaN	NaN
55	300	300	1636.11493	1667.33494	NaN	NaN
56	300	300	1924.24862	1636.75558	NaN	NaN
57	300	300	1576.25204	1836.83154	NaN	16.8465827
58	300	300	1513.76812	1518.49906	NaN	4.74851343
59	300	300	1577.29553	1514.29377	NaN	2.30883154
60	300	300	1666.4792	1542.88531	NaN	NaN
61	300	300	1365.34423	1514.19416	NaN	NaN
62	1347	1285	1328.8607	1280.48847	-8.9803831	-5.3993296
63	1432	1321	1450.47693	1287.04405	-14.211489	-2.660579
64	1359	1300	1342.62795	1285.34724	-1.0150605	-0.2703561
65	1406	1310	1418.24386	1298.88606	-0.7787912	-0.5768824
66	1478	1364	1468.87021	1351.87142	0.53871549	0.70324253
67	1499	1401	1495.51393	1395.67678	0.50951494	0.77056713
68	1569	1457	1564.76584	1453.99309	1.15201288	0.86063584
69	1570	1436	1566.81895	1433.0169	1.26567991	0.97777975
70	1566	1446	1535.4943	1434.67583	1.78722697	1.14664874
71	1597	1478	1581.75386	1473.21147	1.30304228	1.00271849
72	1565	1413	1556.42858	1406.73423	1.48349798	1.1314991
73	1650	1497	1643.30127	1494.79766	1.12857403	1.15496797
74	1720	1599	1716.31564	1599.27	1.46209241	1.28765539
75	1707	1543	1701.42764	1542.3214	1.59695939	1.23196813
76	1753	1606	1746.55398	1604.47593	1.72219583	1.29402146
77	1774	1619	1773.69894	1619.36296	1.74525322	1.30878924
78	1792	1642	1789.48651	1641.8265	1.34895965	1.28309267
79	1811	1670	1810.42127	1670.65455	1.48729955	1.51100115
80	1824	1659	1820.94429	1657.88683	1.53043607	1.49984708
81	1793	1653	1792.44126	1651.85802	1.2964087	1.41360183
82	1876	1742	1875.47424	1742.16021	1.73619294	1.5615551
83	1812	1659	1809.77456	1658.72838	1.25178988	1.39271828
84	1813	1659	1812.19212	1658.38035	1.26229569	1.36224284
85	1824	1720	1821.77072	1720.31204	1.1140071	1.33904211
86	1940	1817	1940.7977	1818.60971	1.47789329	1.41202052
87	1886	1751	1888.80104	1752.72022	1.27763527	1.33245339
88	1947	1782	1949.66956	1784.53695	1.33901184	1.22701567
89	1902	1828	1893.52026	1821.07863	1.20078423	1.26300117
90	1910	1819	1901.84926	1813.67707	1.03611106	1.26663132
91	1891	1797	1886.53189	1793.81628	0.94607902	1.15574433

92	1897	1825	1894.24126	1822.99912	0.8775094	1.02081152
93	1854	1777	1844.73685	1772.99462	0.77057637	1.12639419
94	1941	1843	1940.92924	1841.89515	1.14690818	0.88860186
95	1935	1886	1935.07444	1885.34175	1.08537253	0.8342888
96	1905	1924	1902.92088	1923.94153	1.18543021	1.02716015
97	1931	1868	1931.1467	1867.15633	1.03905861	1.1268497
98	1924	1909	1925.78005	1910.39296	0.691913	0.82061318
99	1987	1917	1987.59745	1917.62197	0.85703179	0.70554334
100	1896	1910	1896.32854	1910.81483	0.76590994	0.84072762
101	2087	2063	2090.87187	2067.13017	0.79188399	0.62735953
102	1987	1989	1989.07953	1991.63147	0.6571656	0.40614477
103	1921	1886	1919.65204	1886.63951	0.92177875	0.55277264
104	1896	1911	1897.10728	1912.31359	0.89299043	0.48598397
105	1846	1830	1846.02682	1829.43384	0.48509867	0.42178677
106	1849	1807	1847.90826	1806.6677	0.51975347	0.46788576
107	1869	1852	1872.415	1850.93916	0.55089697	0.21205167
108	1731	1747	1729.0488	1743.32034	0.6629003	0.28804605
109	1675	1681	1669.43874	1672.12631	0.7639713	0.34768256
110	1737	1625	1723.58498	1613.29871	0.70342064	0.73810726
111	1604	1664	1588.91387	1650.37507	0.9876403	0.50675215
112	1635	1657	1625.51476	1644.86665	0.77319928	0.33898288
113	1552	1557	1523.63677	1526.00076	1.1779634	1.00370957
114	1481	1507	1468.581	1501.06407	0.84569914	0.27407816
115	1532	1531	1525.11623	1527.37164	0.61582689	0.17364121
116	1461	1471	1448.07056	1467.29938	0.82661358	0.24461593
117	1419	1441	1402.84527	1434.79897	1.01253413	0.24855911
118	1440	1443	1427.74005	1434.14552	0.74749881	0.14561855
119	1407	1421	1392.07274	1414.18585	0.74548004	0.16170192
120	1389	1381	1364.39376	1380.44151	1.14838833	0.07382183
121	1369	1386	1371.19611	1386.55528	-0.0268746	-0.1864759
122	1340	1358	1329.95149	1356.20085	0.96682302	0.05633641
123	1344	1364	1336.69848	1354.34856	0.27879175	-0.0541235
124	1341	1332	1336.33885	1321.83746	-0.1938077	0.22321497
125	1302	1299	1266.05578	1290.91203	0.85712325	-0.3366467
126	1267	1290	1264.95029	1261.39648	-1.055719	-0.2838562
127	1250	1276	1185.89642	1222.38874	NaN	0.83527725
128	1262	1270	1262.61921	1259.62002	-1.7481926	-0.7182752
129	1235	1241	1215.85913	1222.54471	-1.3321309	-1.9772983
130	1318	1232	1300.27181	1202.54636	-7.0576403	-3.1670887
131	1203	1302	1172.28207	1228.42406	NaN	-5.2308834

132	1229	1284	1272.55129	1333.89768	-28.4799	-16.280396
133	300	300	1616.21006	1666.79059	NaN	NaN
134	300	300	1575.81104	1636.25792	NaN	NaN
135	300	1299	1513.83359	1223.92548	NaN	NaN
136	895	1289	803.751149	1225.76594	NaN	NaN
137	1273	1248	1253.42143	1224.17179	NaN	-2.7361455
138	1248	1245	1228.97256	1208.5974	-29.900817	-0.6448409
139	1196	1264	1151.5555	1252.11534	NaN	-0.3470372
140	1197	1275	1175.46709	1265.79115	NaN	-0.2675953
141	1195	1291	1187.03918	1278.82935	-1.8080823	0.59773054
142	1215	1309	1199.11535	1299.13869	0.50559309	0.18898874
143	1218	1304	1203.31602	1297.20523	1.22850618	0.41464544
144	1245	1354	1225.12542	1316.4624	0.43407766	0.26122787
145	1259	1354	1252.42757	1351.42036	0.00774452	0.33736796
146	1273	1369	1272.04328	1369.30869	0.71097356	0.29337501
147	1318	1397	1323.32293	1396.62759	-0.0014745	0.37851274
148	1329	1417	1326.49623	1416.82841	0.36944359	0.41136976
149	1344	1428	1344.57932	1428.37902	0.32846718	0.37828215
150	1364	1442	1363.83927	1442.38384	0.22401032	0.42656284
151	1409	1494	1408.1133	1494.28902	0.38696744	0.48975765
152	1425	1494	1420.29416	1492.68585	0.4937134	0.47478355
153	1446	1527	1445.18428	1526.66016	0.27032381	0.50652262
154	1472	1541	1470.27717	1541.1843	0.69561299	0.46093475
155	1522	1616	1521.58848	1617.07491	0.5619609	0.57192256
156	1541	1616	1541.4921	1616.97614	0.52113002	0.57017702
157	1526	1582	1524.79274	1581.41025	0.6063439	0.56262146
158	1534	1579	1529.74958	1577.37133	0.5526941	0.57298914
159	1590	1662	1589.85835	1662.80506	0.540527	0.65459538
160	1598	1697	1598.83941	1698.03827	0.67041734	0.59177285
161	1605	1677	1605.41441	1678.49482	0.96598234	0.52730036
162	1628	1715	1628.87912	1716.66914	0.79656331	0.5702924
163	1645	1686	1639.631	1683.95829	0.88625653	0.53572315
164	1695	1799	1695.66053	1799.63402	0.9806942	0.55158928
165	1666	1767	1662.71951	1766.57017	0.79857615	0.59027087
166	1652	1745	1650.55432	1742.68681	0.98823374	0.57870827
167	1722	1825	1722.89257	1826.54246	0.95474593	0.70930553
168	1727	1843	1727.22725	1845.06392	1.27062103	0.55449581
169	1734	1906	1736.54487	1907.66774	1.16442605	0.87314071
170	1607	1723	1604.22292	1722.53419	0.96242914	0.68564448
171	1596	1691	1591.37596	1688.91011	1.07255271	0.58228795

172	1542	1635	1537.3123	1630.21595	1.24840524	0.67396483
173	1520	1618	1512.50743	1610.18823	1.09761272	0.61996913
174	1504	1570	1492.45075	1560.89961	1.17265865	0.5234533
175	1485	1570	1484.47776	1571.14483	0.78884312	0.36143915
176	1487	1553	1479.12822	1553.71174	0.74486551	0.35868166
177	1430	1505	1425.81578	1504.44102	0.92836804	0.33079487
178	1398	1455	1392.87804	1453.73409	0.89062338	0.30638945
179	1384	1451	1382.81043	1449.61441	0.91127547	0.35340485
180	1338	1414	1336.06768	1410.35156	0.71480786	0.09551817
181	1344	1398	1335.65412	1392.91328	0.93099973	0.3314973
182	1310	1354	1293.65237	1346.42987	0.58009201	0.21034857
183	1301	1340	1290.23223	1336.51127	1.19784793	0.10498114
184	1299	1319	1280.67539	1314.24759	0.47150044	0.12932882
185	1279	1326	1267.51677	1322.13504	2.77149678	0.13707523
186	1264	1312	1228.99903	1300.45394	NaN	0.39895561
187	1263	1284	1235.01209	1271.36169	1.71544668	0.39069064
188	1211	1249	1175.14184	1232.42709	NaN	0.53598211
189	300	300	1565.30535	1636.98398	NaN	NaN
190	300	300	1519.85296	1412.99981	NaN	-13.437794
191	1423	1340	1340.37542	1311.80361	NaN	-2.5123569
192	1448	1340	1415.43049	1327.53363	NaN	-1.6123129
193	1407	1349	1354.61952	1334.22473	-2.4724797	-0.883386
194	1403	1376	1374.17458	1368.11121	0.16213021	-0.389745
195	1415	1418	1420.7877	1415.08037	-0.0901224	-0.0690669
196	1451	1460	1447.13258	1459.21058	0.86810643	0.16629762
197	1512	1482	1503.04339	1481.00019	0.85999013	0.25365443
198	1570	1544	1568.61729	1544.46805	1.16556911	0.46429402
199	1628	1623	1628.80917	1623.57407	1.41324236	0.56746406
200	1640	1655	1638.44582	1654.64953	1.53802284	0.66122421
201	1662	1668	1661.12911	1667.96712	1.69766315	0.64539608
202	1700	1709	1699.77744	1709.50098	1.83905638	0.81012643
203	1700	1709	1700.34172	1709.05697	1.67570118	0.83487305
204	300	300	1734.76702	1938.63145	1.3421638	2.21994936
205	1718	1868	1720.77378	1870.44568	1.22943216	1.72918091
206	1674	1882	1674.36835	1881.29569	0.84691736	1.82749314
207	1675	1848	1664.1804	1843.47069	1.37765272	1.74779258
208	1597	1743	1574.54164	1730.4413	1.38512793	1.43076511
209	1553	1718	1528.71841	1704.84382	1.738891	1.63279369
210	1528	1674	1519.99647	1673.12504	1.46720042	1.24121805
211	1467	1583	1461.8565	1577.34765	0.80736288	1.23346424

212	1418	1524	1395.86614	1517.28428	1.81919484	1.22806619
213	1411	1523	1400.2843	1518.17701	1.21089768	1.08522401
214	1396	1477	1364.96036	1465.73242	1.68973432	1.11028072
215	1378	1471	1357.75226	1466.23856	0.76279211	0.86489362
216	1339	1436	1315.46071	1431.28017	1.44498311	1.1041401
217	1346	1410	1291.53642	1397.75563	1.93831771	1.08327465
218	1310	1371	1304.19946	1368.34493	-0.2816544	0.13403558
219	1284	1340	1279.75891	1337.97711	-1.9727431	0.13366813
220	1223	1322	1215.82131	1300.81009	NaN	-0.3815441
221	1247	1311	1180.31057	1297.60068	NaN	-0.3568776
222	1309	1340	1289.54349	1293.08227	NaN	-3.1226526

	Files	**~pressure**	**notes**
cell 5_2 - mix	2 thru 132	39-42 GPa	same sample as 10/10/20
"	133 thru 188	31-35 GPa	
"	189 thru 222	33 GPa	